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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 59.

D. E. SALMON, D. V. M., Chief of Bureau.

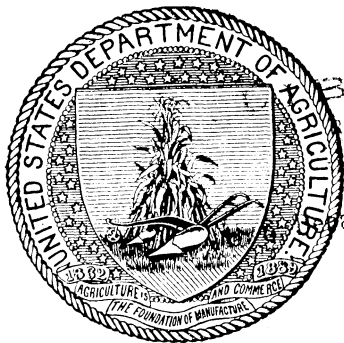
THE FARM SEPARATOR:

ITS RELATION TO THE CREAMERY
AND TO THE CREAMERY
PATRON.

BY

ED. H. WEBSTER,

*Inspector and Dairy Expert, Dairy Division,
Bureau of Animal Industry.*



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1904.

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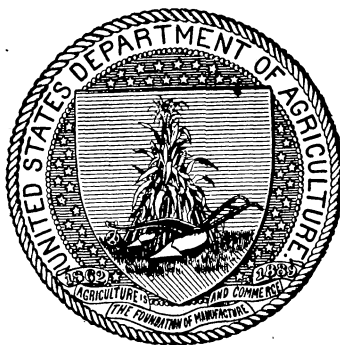
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1904.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 26, 1904.

SIR: I have the honor to transmit herewith a manuscript entitled "The farm separator: Its relation to the creamery and to the creamery patron," prepared by Ed. H. Webster, inspector and dairy expert, under the supervision of Maj. Henry E. Alvord, Chief of the Dairy Division. In submitting this manuscript for my consideration, Major Alvord gives an outline of the work, from which I quote:

"This paper embodies in part the results of Mr. Webster's investigations and experiments during the last calendar year. It will be of general interest, and particularly useful in the districts where dairy-
ing has been recently introduced on the farm-separator system.

"In order to assist in the investigation thus reported the Continental Creamery Company of Kansas offered the use of a part of its regular daily shipments of cream to the factory at Topeka, from producing farms nearly 300 miles distant, keeping the transportation under control, and permitting a full examination to be made of the selected cans of cream upon arrival at the factory. The company also contributed the services of its chemist, Mr. C. E. Gray, to assist Mr. Webster in these experiments, and Mr. Gray was temporarily appointed a special agent of the Bureau of Animal Industry.

"The Post-Office Department courteously made a special ruling which permitted the data to accompany the cans of cream in tag envelopes instead of being separately mailed, and thus contributed much to the facilities for conducting the experiments."

I respectfully recommend that the report be published as Bulletin No. 59.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON, *Secretary.*

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THE FARM SEPARATOR: ITS RELATION TO THE CREAMERY AND TO THE CREAMERY PATRON.

By ED. H. WEBSTER,
Special Agent and Dairy Expert.

INTRODUCTION.

This subject is treated in this bulletin wholly from the standpoint of Western practice. The section of the West in which the observations were made lies almost altogether within the boundaries of Kansas and Nebraska. Not formerly in the list of dairy States, these two have had a history in dairying both unique and interesting. The first lessons in the industry were paid for by the farmers, at the rate of about \$100 per lesson, in cooperative stock creamery companies which had been organized by persuasive and persistent promoters. These lessons were well impressed and are remembered even to the present day, although the creamery, with its \$6,000 or \$7,000 investment, has long been used for purposes quite foreign to its original intent. No doubt farther East, where there were more dairymen, investments of this sort made by the farmers turned out better and such ventures were often successful. West of the Missouri River the farmer was not a dairyman and had no intention of becoming one; and although he took a hundred-dollar share in the creamery he was skeptical as to the outcome and did not propose to sell any cream until the venture was a success. He may not have known that this very attitude wrecked all prospects of success. Here and there were exceptions to the usual failures which the first lesson brought. These exceptions only served to prove the rule that where there were no cows, no experience in the business, and no inclination to become dairymen a cooperative or a stock company creamery could not live. The few exceptions were in neighborhoods where the farmers went to milking and stuck to it. These earlier creameries were on the "gathered-cream" system—a system in which every step was ruinous under Western conditions.

Along in the early nineties the skimming station began to make a sweeping change in creamery practice in these Western States. A new impetus was given to the business, and again the farmer was urged to put up his dollars for another lesson. The idea had been conceived of skimming the farmers' milk at a station and shipping the cream to a central point for churning. This lesson usually cost the

farmer about \$25, and the result was much more satisfactory for a time than the first had been. A station was built which the farmer owned and a creamery was leased. The farmer hauled his milk to the station and hauled his skim milk home. The average distance was not less than 6 miles. One thing that helped the industry at this time was a general period of depression, the cow seeming to be the only thing which would yield an assured income. Although prices of butter were comparatively low, the business boomed. Following this, a few prosperous years came and the farmer wearied of the long haul and the small returns he was getting. He hired out the hauling; this ate up the profits. With easy money in other lines of farming and but little profit in the milk business, dairying again had a setback. Skimming stations became expensive to operate because of the small amount of milk handled, and it looked as though many of the small centralizing plants had met their doom. For mutual protection and with a hope of building up the business again, many of these smaller creameries consolidated, forming large companies.

A few enterprising men had by this time taken up the crusade for the farm separator.^a They were frowned upon by all conservative creamery men. Separator agents multiplied, however, and began to pile up evidence that the farmer could cut off the great expense of hauling milk both ways, and farmers began to buy. This was the third lesson they were paying for. The \$100 necessary to buy a separator was a mountain of difficulty at first, but the trained separator agent could figure profits that would finally tempt the most conservative.

It soon became evident that the farmer was going to have a separator. The conservative creamery man now began to see that if the farmer bought a separator and was opposed by his creamery in so doing the cream would go somewhere else. This opened up the whole territory west of the Missouri River and the creameries, large and small, began to push the farm separator for all they were worth. The separating station dropped out of view almost as suddenly as it had appeared, scarcely ten years before. The strenuous time in the farm-separator business was now partially transferred from the field

^aThe machine here referred to is the centrifugal cream separator, or the dairy centrifuge. The invention was brought to this country from Europe about 1879, but was not generally adopted until some years later. The first centrifugal cream separators were hand machines operated by a crank. Then steam power was used, applied by belt and also directly, as in the operation of turbines. Separators have become commonly known through the use of power machines at creameries and separating stations. The farm separator is the same machine—the centrifugal cream separator—of a size and pattern suited to do the work on the farm. Generally it is small and operated by a crank turned by hand. But it may be fitted for use with a dog, bullock, or other animal, or by water, or any power convenient on the farm. Hence while the farm separator is usually regarded as a hand machine, the way in which it is operated is merely a matter of suitability and local economy.—H. E. A.

to the factory. Separator companies could not keep up with their orders. Farmers could hardly wait until a machine could be delivered to them. To be sure, this great demand was not created in a day. The pioneer work for the farm separator was slow and discouraging to those who were carefully fostering its interests. The farmer had already bought a creamery and then a skimming station, and it was almost the "last straw" to ask him to buy a separator. Here and there a machine was sold and the leaven began to work. To-day the creamery business of Kansas and Nebraska is a cream-gathering system, and the farmer has the separator in his home. In the more thickly settled portions a few skimming stations still remain, but their days are numbered.

The day of speculation as to the probable trend of the business is past. The farmer now has a separator and the creamery has the product from it. The question is no longer, Will the creamery man sell machines? but, What can the farmer and the buyer of cream do to make their use more profitable to all concerned? This issue must be met intelligently on both sides. The farmer must learn that he has a big part in the final success of the system and the creamery man must learn that it does not all depend upon the farmer, but that there are things in factory management which he must study and put in practice. So interwoven are the lines leading to success that one side of this question can not be discussed with any completeness without also taking the other side into account. As a matter of convenience, as well as for logical sequence of events, the discussion will begin with the farmer.

I. ADVANTAGES OF THE FARM SEPARATOR TO THE DAIRYMAN.

The reason for the rapid spread of the farm separator among the dairymen of Kansas and Nebraska has already been suggested.

RELATIVE COST OF HAULING MILK AND CREAM.

The average distance of hauling over this territory is about 6 miles. The farmer grew tired of this steady job himself and then of paying the profits to some one else for doing the work, and finally he quit the business. The cost of hauling the milk both ways, in the farmer's time or in the money he paid for hauling, was a greater tax than the industry would stand. This cost was never less than 10 cents per 100 pounds, and it was often 15 cents or more. This meant a direct tax of $2\frac{1}{2}$ to 5 cents per pound on butter fat that was worth but 15 to 20 cents when delivered. No industry could stand this tax and live. It ought not to stand it. This tax on the business furnished one of the leading arguments for separator salesmen, and rightly so, but, like most good things, this argument was abused. The farmer was making the trip every day with his milk to the station. It was held out to him

that with the separator he could go once or twice a week, or whenever he got a canful of cream. This was an easy argument, and it took well. The creamery men saw the danger, but for the time seemed powerless to act. They accepted it as an inevitable result of the introduction of the farm separator and fought against its introduction. But they were powerless to lower the cost of hauling milk and had to accept the change. There is, however, one thing that the farmer will yet have to unlearn, if he has not done so already. He must recognize that cream is a perishable article, and under the most favorable conditions will soon become unfit as a food product.

The change to the home separator proved a means of reducing the cost of hauling, in time or money, to 1 cent or less per pound of butter fat. This difference in cost between the two methods went into the farmer's pocket. The result was an increased interest in the business and greater receipts at the creameries.

COMPARATIVE VALUE OF FARM-SEPARATOR SKIM MILK AND CREAMERY SKIM MILK.

One of the great drawbacks of the old system was the serious loss in the value of the skim milk. The long haul to the station and the long haul home consumed from five to eight hours, and often more. When the cans of skim milk were delivered at the patron's door the milk was usually in bad condition, and the calves that were forced to drink it were in a worse one. The skim milk was one of the things that never failed to bring out a strong argument against the dairy business. Wise ones often filled the dairy papers with articles about how to feed skim milk to calves successfully, but these wise ones didn't live at the end of a 12 mile route, where they had to feed the article as it was delivered to them, after being from eight to ten hours on the road. It was a common story that skim milk killed the calves and pigs and was not worth the hauling home. This was probably much overdrawn, for it was very difficult to buy any of this skim milk at the factories. It was not so good as it should have been, but it was needed and recognized as indispensable by every farmer. The introduction of the farm separator, however, wrought a great change. In visiting hundreds of farmers who are using farm separators, the writer has not heard one word of complaint on the score of the skim milk. Calves, pigs, and chickens are greedy for it and all are doing well on it. Men who would never consider the business under the old system have been convinced that, with a separator at home, they can raise good calves, and have become creamery patrons.

INCREASE IN THE BUTTER FAT.

Many authentic instances are on record where the farmer has sold from one-fourth to one-third more butter fat from the same herd after buying a separator; not that he did not get pay for all butter fat that

he delivered to the creamery when he hauled milk, but because he did not deliver all the butter fat to the creamery. The skim milk was coming back from the creamery in condition unfit for the calves. New milk was fed them instead. This happened often, with the result that the calf was eating butter fat worth from 15 to 20 cents per pound when an equal amount of corn chop worth about 2 cents per pound would have served almost as well. When the farm separator was bought, the calves were weaned earlier from whole milk; in fact many of them got no more whole milk. The butter fat was sold. Then again many who hauled their own milk had to quit for a while in the busy season. They could not spare a team to take the milk in. When they bought a separator the children with the old family horse and cart delivered the cream as regularly in these busy seasons as in any other. Under the old system occasionally a can of milk would sour and be returned, and Sunday's milk could hardly ever be kept over. With the separator this never occurred. Thus many farmers were very much surprised to find their monthly checks from one-fourth to one-third larger than they had been before.

INCREASED NUMBER OF COWS.

When the separator was purchased the farmer found he could just as well milk a few more cows. He had plenty of cans; he did not have to spend a half day delivering the milk; and, besides, the separator had to be paid for. The result has been an increased number of cows in the dairy and a corresponding increase in income per farmer all over the territory under consideration.

INDEPENDENCE OF CREAMERY.

There came to each purchaser of a separator a feeling that he was independent of any one concern. This, while not a matter of advantage perhaps in actual income, was a mental relief that was worth something. The cream could be shipped far or near just as he chose or as the creamery man could interest him. This feature of the farm-separator system has not done as much damage to the creameries as they at first thought it would. The farmers find their home men honest and stand by them.

INCREASED PRICE FOR BUTTER FAT.

The increased price of butter fat was an argument that was used to good effect and with some truth. A few creameries went so far as to pay more for butter fat shipped by the farmer direct than for that which the station was made the medium of gathering. The price paid to farmers is higher in proportion to the butter market than it was under the whole-milk system. This results from competition to get

business and also from the fact that there is less expense, on the whole, attached to the cream system. This increased price may, however, be temporary, as will be pointed out further on.

THE DANGERS THE FARMER IS APT TO ENCOUNTER.

There are apparently no dangers that have been real; but some serious ones may develop unless the farmer studies the situation and follows the instructions given him by his creamery. With the introduction of the farm separator, where everything is so obviously to the advantage of the farmer, he should not forget that the success or failure of the whole enterprise hinges largely on the demand there may be for the product of his separator. If the creameries are forced to turn out a second-grade or third-grade product because of inferior cream, sold by indifferent farmers, the disadvantages to the farmer may become painfully apparent to him. The fact is that, up to the present date of writing, the quality of butter produced from farm-separator cream has been inferior to what it was in the same territory under the whole-milk system. This has caused much loss to creamery men and will ultimately react on the producer of cream, unless he takes some radical steps to better the quality of his product. With this thought in view, the matter of the care of the separator and the cream will be discussed. It is hoped that the farmer will take this matter to heart and seriously consider the question of his future profit in the business and how he can best obtain it.

II. THE FARM SEPARATOR: ITS CARE AND MANAGEMENT.

Separator companies issue books of instruction with each machine which are sufficiently clear and comprehensive. These will insure good care of the machine if followed. It sometimes happens, however, that the purchaser thinks he knows more about the machine and how it should be used than the manufacturer. Such a one generally comes to grief.

THE MECHANICAL OPERATION OF THE MACHINE.

The separator is made for one specific purpose—that of skimming milk. The skimming is done wholly by centrifugal force—that force that makes a ball pull on a string if it is attached to one end and whirled around the hand in a circle. The pull that is exerted through the string, as though the ball were trying to get away, is the centrifugal force. The centrifugal force in a separator causes the milk to flow away from the center of the bowl and hug the inside of the bowl wall. The skim milk thus forces its way to the parts farthest from the center, while the cream, which is lighter, lags behind and collects in the middle of the bowl. Strictly speaking, the skim milk, being heavier, is separated from the cream by the action of centrifugal

force, instead of the cream being extracted from the milk. Openings on the outer edge of the bowl carry off the skim milk and an opening near the center carries off the cream. One is discharged below the other and they are caught in different pans or receptacles and thus carried away from the machine.

The various patterns of separators found on the market have different devices in the bowl for aiding the separation. These are always purely aids. The old style hollow-bowl machines had simply a bowl with a wing soldered to the inside in a line with the axis or central shaft to make the milk revolve with the bowl. There was more or less remixing of cream and milk after it started to separate, and the efficiency was low both as to closeness of skimming and to quantity of work done. Every internal device used in separators has been put there to overcome these difficulties—to keep the milk from remixing, to make it pass through the bowl in a steady flow, and to divide it up in such ways that a greater quantity of milk can be passed through the bowl and receive the action of the separating force. The steady even flow secured by these devices is also obtained or helped by a perfectly steady and uniform motion of the bowl. If the machine shakes while it is skimming there will be some intermixing of the milk and cream and the result is poor skimming. The operator should aim to secure two things if he expects his machine to do good work: (1) A perfectly true motion of bowl, and (2) a sufficient speed (which must be uniform) to create force for separating.

In order to have the perfect motion of the bowl, the machine must be set level and be kept clean and well oiled. The oil should be thin, or light, so that it will not gum the wearing parts. A heavy oil will make the machine run hard and will gum quickly on small high-speed bearings. All the bearings of the machine should be frequently flushed with coal oil. It is well to make a run about once in two or three weeks, using coal oil on all the bearings. This keeps the parts free from gum and washes out grit or sand that may have blown into them. It is an excellent plan to have a cover of close-woven cloth or oilcloth, that can be kept over the machine while it is not in operation. This will keep out dust and sand and will add materially to the lasting powers of the machine. The separator should be set up on a good solid floor, so that it will not move about as the operator turns the crank.

Uniform centrifugal force is obtained by turning the crank at a given speed at all times and giving the crank an equal pressure at all points in its circuit around its axis. All machines have marked upon them, or given in the instruction book, the number of revolutions the crank should make per minute. Follow these instructions, counting the revolutions each time the machine is operated and frequently during operation, to be sure the speed is maintained. This is a point

in which much careless work is done. Too many guess at the speed, and they seldom guess right. It is a good rule never to guess at anything when it is possible to know. The writer has found variation all the way from 25 to 75 revolutions per minute in the operation of machines by guess. At neither of these extremes would the operator believe that he was wrong, until he had been made to count the number of revolutions by the watch.

The life of a separator depends mainly upon the factors just pointed out. A machine that is allowed to run gummy or dirty may wear out in a year. If kept free from dirt and well oiled it will last a number of years. One of the objections urged against the separator has been that it would not be properly handled and that one or two years' service would wear the machine out. After visiting several hundred farms and inspecting as many machines, the writer has concluded that the farmers, as a whole, are taking much better care of their separators, mechanically, than was anticipated. Machines have been noted that had seen several years' service and were still practically as good as new. In a few instances careless operators had nearly worn a machine out in less than twelve months. The farmer never bought a machine before in the use of which he was so frequently and urgently reminded that he must take care of it.

SPEED OF MACHINE.

This has already been discussed, but it should be noted here that the greater the speed the greater the centrifugal force, and thus the greater the efficiency in separation. The speed at which a machine should be run is indicated by the manufacturer. Never run less than this; it is not practicable to run more. Slow speed has two effects on the work of the machine: (1) The separation will not be complete and (2) the cream will be thin. The incomplete separation means a loss of butter fat left in the skim milk. This loss should be avoided, and it can be by running at the required speed. Count the turns of the crank by the watch.

QUANTITY OF MILK FLOWING THROUGH THE BOWL.

In most machines this flow is fixed by the size of the opening and the height of the supply can; in some it is not. Within certain limits the amount which passes through the bowl has a decided effect upon the separation. The faster the milk passes through, the shorter the period in which the centrifugal force acts on it and the less complete is the separation. If the amount of milk is turned off about one-half, by partially closing the faucet over the bowl, the cream will be thicker. It may become so thick that it will not flow from the machine. If the float should be removed and the pan be allowed to run full of milk, without any other change of condition, the cream would be very thin.

In this, as in change of speed, the quality of the skimming is affected. The greater the supply of milk the less perfect the skimming, and if the supply should become so small that the cream would not flow from the machine, all of the milk would pass out through the skim-milk tubes.

TEMPERATURE OF MILK.

The warmer the milk the more fluid it is. It is a rule adopted by all creamery men in operating power machines that the milk must be separated at a temperature above 85° F. Cold milk is more viscous, or less fluid, than warm and the cream will not separate so readily. If this is true of power machines, where everything runs more uniformly than is possible with a hand machine, it is certainly true of the hand machine. It is one of the stock arguments of some separator agents that their machine will skim cold milk. Probably the statement is true. If so, it shows a wide range of adaptability for the machine and that it is so built that it is difficult to clog up. Take the argument for what it is worth, but do not skim cold milk unless you expect to leave some butter fat in the skim milk. The milk should be separated as quickly as possible after milking; then the skimming will be cleanest, the skim milk will be best for the calves, and the cream will keep better.

THE CREAM SCREW.

The function of the cream screw is to regulate the percentage of butter fat in the cream separated, and enable the operator to make allowance for changes of season and character of milk to the extent that a uniform cream may be obtained under all conditions, if so desired.

One of the most frequent questions asked is, "Why does my test vary so much?" The reasons have nearly all been given in the foregoing paragraphs. The test varies with the speed of the machine, with the amount of milk run through the machine, and with the temperature of the milk. Every machine has some device for changing the test of the cream when these factors remain constant. It is done either by an adjustable outlet for cream or skim milk. In most cases the adjustment is in the cream outlet. Directions for adjusting the cream screw are given in the books of instruction that go with the machines. There are some factors of separation not mentioned above which influence the percentage of fat in the cream. These factors are usually overcome by proper adjustment of the cream screw. In the summer, when the cows, on green, succulent pasture, are at their best and giving large quantities of milk, the milk is easy to skim. The reverse is true in winter if the cows are wholly on dry feed. It is usually the case that milk tests higher in butter fat in winter than in summer if most of the cows calved in the spring. These facts have their influence on the test of the cream. As a rule, rich milk will give

the richest cream, other things being equal. It will give no more butter fat than is contained in the milk, but the cream will be richer in butter fat. The proportion of milk to cream remains about the same, therefore the cream tests richer in fat. It thus happens that in winter the cream screw has to be set so it will make a larger quantity of cream from a given amount of milk than is customary or necessary in summer.

THE SANITARY CONDITION OF THE MACHINE.

If the mechanical care of a machine is important as affecting its durability, the sanitary care of the machine is doubly so as affecting the purity of the product which passes through it. Milk—one of the best and purest of human foods—is one of the quickest to become unfit for food if it is not kept clean and handled in clean vessels. While the purchaser of a separator has been again and again impressed with the idea that it must be kept in perfect order, the same agent who went to such pains on this point has told him that the parts which come in contact with the milk need not be washed oftener than once a day and that the cream could be delivered once a week. It would be one of the greatest blessings to the dairyman, the creamery man, and the consumer of butter if the machine should go to pieces in a month if not kept scrupulously clean every minute of the time. It is right here that the advantage of the hand separator to the farmer may turn to naught unless the fact that cleanliness, which is so essential to purity of product and to profit in the business, is thoroughly impressed upon the user. It is not enough to rinse the machine out with a little warm water and let it stand until next time. It is the slime and solid particles of unclean matter in the milk that are caught and held in the bowl. The temperature is just right to set this material to decaying at once; and if the parts are not clean, an evil smell soon develops. The machine must be well washed after every separation of milk.

There are some things that the average housewife needs to learn about washing vessels that come in contact with milk. The dishcloth as found in the average kitchen should never be used on dairy utensils. It is the exception where one will be found to smell sweet an hour after it has been used; and yet milk utensils are often washed with it and wiped with a towel that has done duty on all of the china and glassware of the household, and possibly the pots and kettles, before the tinware of the separator is touched. Discard the dishcloth and the dish towel when the milk utensils are being washed. Wash them in warm water first, with plenty of some washing compound, and use a brush to do the work, but never a rag. Get into every part of them, after which rinse off with clean warm water, and then either put them in boiling water or pour boiling water over them. Stand the parts up so that they will drain, and

use no cloth to wipe them. The hot surface will dry them quickly, and they will be clean. Leave the parts in a sunshiny place if possible. This may seem to be putting too much stress on the case, but evidence gathered in the field shows the need of some vigorous words along this line. The outside of the frame, which does not come in direct contact with the milk, needs the same scrupulous care. Cases have been noted where the color of the machine could scarcely be distinguished because of the grease and dirt or dried milk covering the paint. Pure cream could hardly be expected ever to come from such a place. It is pleasant to know that at more than three-fourths of the farms visited the separators were well kept and the people were trying to do the best they knew how. There was, however, a great lack of knowledge, and this should be supplied to the users of separators in some way or another. It is hoped that this bulletin may do something in that line.

III. MANAGEMENT OF CREAM ON THE FARM.

The dairy industry of Kansas and Nebraska is comparatively new. It is not the main business of the farmer, but rather a side issue, forced upon him by adverse conditions or aggressive creamery agents. The farmers of this section have never given the matter their serious attention. They know that it brings them in a steady income, but it is confining, and they will not milk unless they have to. This is the general condition of the business. With this as the prime incentive, the farmer feels that he does not want to put any expense into the business that is not necessary. This line of thought has practically prevented him from spending any money for better care of his dairy products. He has the cows and the separator, and the market that takes his cream asks but little of him in the way of quality. Naturally, but little has been done to keep the product pure from the time the cow has been milked. Times are changing rapidly in this respect. The creameries are requiring quality tests to be made of the patron's cream and are paying for it on that basis. This is going to bring the farmer face to face with a new proposition. He must learn how to care for his cream in such a way that he may deliver it to the creamery in perfect condition.

CLEANLY MILKING.

This is the starting point of most of the trouble with cream: The milker sits down with a pail, open at the top, and begins to milk. Any dust, straw, or manure that may be hanging to the udder is gradually worked off and finds its way into the milk pail as the milking proceeds.

It is not the province of this bulletin to enter into any lengthy discussion of the subject of bacteriology, but enough must be said to give a clear understanding of the effect of mixing with the milk this dirt from the hair and udder of the cow. Every particle of such dirt carries with it a quota of germ life. This germ life consists of minute plants, so small that they can not be seen without the aid of a microscope. The function of this plant growth is to cause decay. All decay is brought about by the action of this germ life, or bacteria. Germ life requires certain things to promote growth, just the same as does corn, wheat, or any other plant with which the farmer is familiar. The corn requires food, moisture, and warmth to make it grow and thrive. These must be furnished at the right time and in the right form or the corn does not thrive. It is just so with germ life. The germs require proper food, warmth, and moisture to grow. All of the conditions which best promote the growth of these minute, invisible plants are found in warm milk as it is drawn from the udder. Thus while the dairyman milks he unconsciously plants; he plants the seed of destruction in the very product he is going to market. The destruction begins at once and is carried on very rapidly so long as the proper temperatures are maintained.

The remedy would naturally suggest itself. Stop the dirt from getting into the milk. This can be done easily and quickly. If the milker will carry with him a damp cloth and carefully wipe off the udder and the parts immediately around it, the trouble will to a great extent be prevented. All of the coarser particles of dirt will be rubbed off and the finer particles of dust dampened so that they will not fall into the pail. This work will require but a few moments of extra time and would prevent much after-trouble in the way of sour and ill-flavored cream. The cow should be milked in a place in which the air is free from dust. In the winter, or when the cows are kept in the stable, never feed, or move hay, or clean out the place, or do anything to stir up dust or strong smells just before milking.

SEPARATING.

The cream should be separated at once after milking, while the milk still has the animal heat in it. The work of the day should be so arranged that this can be done. Do not use a cloth strainer. The separator will remove all the solid dirt that may be in the milk much better than it can be done with a strainer. There never was a cloth strainer used that would not in a few days become yellow and smell bad. Under the best conditions, where steam can be used to help in cleansing, the cloth strainer is more of a snare than a benefit. A well-made wire strainer might be used, but there is no need of any strainer. Pour the fresh, warm milk directly into the supply can and send it through as quickly as possible.

COOLING THE CREAM.

At once on finishing the skimming begin the cooling of the cream. The calves can wait a few minutes better than can the cream. There are devices made for cooling the cream as fast as it comes from the separator. They are good and can be made of much service if kept clean, but they add to the number of utensils that have to be washed and, like the strainer, they may be dispensed with. The dairyman should provide himself with enough cans, made after the old style "Cooley" or "shotgun" can, to hold the cream. A can of this kind holds from 3 to 5 gallons, is about 20 inches deep and 9 inches in diameter. These cans are the best to keep the cream in at the farm. They are convenient to use and keep clean, and they present a large cooling surface, which is a great advantage in cooling cream.

Immediately after separating set the pail or pails of cream in a tank of cold water and stir, testing the temperature with a thermometer until the cream is as cold as the water. This point is imperative if success is to be obtained. As with the cleaning of the cow, this is a matter of a few extra minutes, but it will be a factor in deciding success or failure. The stirring rod and the thermometer should be considered as indispensable as the crank on the separator, and yet hardly one in five hundred farmers of the West have a thermometer that can be used for this purpose. If the can of cream is set in a tank of water and left without stirring, it will be hours before it becomes thoroughly cool. In the meantime the germs which have gotten into it in spite of the greatest of care have been multiplying at a tremendous rate and the cream goes to the station spoiled. At the temperature of ordinary well water the development of the germs is very slow, and for this reason no time should be lost in cooling the cream to this temperature. The thermometer is absolutely the only means by which one can tell whether the cream is cooled or not. By stirring and testing with the thermometer frequently the task of cooling will be found to be short and one will quit with the satisfaction of knowing that the cream is cool. It ought to be cooled down to 60° F., and if the water is cold enough to carry the cream lower so much the better.

HOLDING THE CREAM.

Generally speaking, there is almost an entire lack of facilities for holding cream on the Western farm. The majority of farms have wind pumps at or near the house. The pump furnishes an excellent location for an ideal milk house. On many farms visited the owner had built around the windmill tower, or at one side of it, a building, usually 6 by 8 feet; in which was placed a tank deep enough to set the milk cans and have water come up to their necks. All of the water

pumped for stock and other purposes of the farm is run through the tank and then out into the stock tank. This room often contains the separator and a work table; in fact, here is done the dairy work of the farm. With an arrangement of this kind and a good thermometer the cream should be kept without difficulty from forty-eight to seventy-two hours in the hottest weather. Such a building costs but little, and the convenience of having a place for the milk, cream, and dairy utensils is in itself enough to justify the expense of building it. As a matter of fact, the farmer who is going to get the best price for his cream will have to provide himself with a place to keep it cool until it can be delivered to the station. Keep it just as cool as is possible, without freezing, up to the time it is delivered.

There are some points besides the immediate cooling and holding at a cool temperature that must be observed in order to insure good cream. The different skimmings of cream should never be mixed until both are of the same temperature. The cream when cooled down keeps fairly well, but if some warm cream should be mixed with it the temperature will be raised. At once the germ life becomes more active and souring takes place very quickly. No vegetables or other produce having strong odors should be kept in the same room with the cream. It takes such odors very readily and retains them tenaciously. In fact, keep the milk room for milk and nothing else, and, above all, have plenty of windows to admit sunshine when wanted, and use plenty of "elbow grease" in keeping it sweet and clean.

1 DELIVERING THE CREAM.

In many instances all the good work done is entirely spoiled because the cream is not cared for in delivery. The writer has observed many thousand cans in process of delivery, and in nearly 99 per cent of them the work was done in such a manner as to damage the cream. For some reason, probably through lack of better information on the part of the person delivering the cream and also on the part of the man receiving it, the cream was handled as though no damage could come to it after it was taken away from the farm. It mattered not whether the heat of the summer's sun or the cold blast of the winter's storm was on, the can of cream was exposed to it all. Withdraw the lid of a can of cream that has been exposed to the heat for one or more hours and the first whiff is a sour one. The cream will be found to be several degrees warmer than when taken from the water tank at the farm. This warming has the same result as mixing warm cream with cold: The germ life is made active and the souring process goes on with greater rapidity than before. It is a simple thing to cover the cream can with a wet sack or blanket and throw over this a dry one, which will effectually stop the mischief. With this precaution the cream will arrive at the station as cool as when taken from the

farm. Why this should be so commonly neglected is almost beyond comprehension, but it is the most universal of all wrong things done by the farmer in the production of pure cream. The same precaution, except that the blanket should be dry, is a sure protection against freezing in winter. Creamery men should insist that cream be delivered properly, to avoid the loss which occurs constantly through carelessness of this kind.

FREQUENCY OF DELIVERY.

It is a safe proposition to say that in 95 cases out of 100 the cream is not delivered oftener than three times per week in summer and twice a week in winter. There are many reasons for this. The objections given to hauling milk apply to cream and are met by less frequent delivery. The distance of hauling is not less than 6 miles on the average, and it is a question whether the patron can afford to make the trip more than three times per week. Some of the larger creameries receive cream but three times per week and others four times, while a number keep their stations open every day except Sundays. From 80 to 90 per cent of patrons of stations that are open every day do not deliver oftener than three or four times per week. The direct shippers, or those who take their cream to the railroad station and ship directly to a central plant, make from one to five shipments per week. The larger number of this class will not average over two shipments per week. They hold their cream until they get either a 5, 8, or 10 gallon can filled. There is a tendency in some quarters to urge farmers to more frequent delivery and in others to insist on better care of the cream between deliveries. The creameries which operate their stations but three times per week are forced to the latter alternative.

The question of delivery should not be placed upon a par with keeping cream at the farm; or, in other words, there is a difference that should be noted on the part of both the creamery and the patron which is of importance to each. The cost of keeping milk and cream at the farm is practically paid when the equipment is put in to properly handle it. This equipment need not be renewed for years if it is properly cared for. The time required to put the cream in shape for keeping, over that spent by the dairyman who neglects this part, is very small. On the other hand, the hauling takes time for every delivery and the cost is always that much more for each delivery made. The investment is never completed, but has to be worked out as time goes on. It is plain that the more frequent the delivery of cream the greater becomes this part of the expense. If it can be shown that cream can be kept forty-eight, sixty, or even seventy-two hours, and delivered in good shape every second or third day without any expense other than a few minutes of attention each day and one original investment, the farmer would not be justified in making six trips per

week where three would do the work, thus doubling the cost of delivery. It is worth the farmer's time to study this question and secure the proper equipment for handling the cream on the farm. Under the ordinary practice now in vogue, with imperfect facilities at hand, the cream is not delivered sweet in 90 per cent of the cases when it is more than twenty-four hours old. This is not because it can not be done, but, as pointed out in the preceding paragraphs, because proper care is not taken before the time of delivery. Let the instructions of the preceding paragraphs be followed, and then the cream can be delivered three times per week in sweet condition.^a

IV. RESULTS OF INVESTIGATIONS MADE AT COLBY, KANS.

Several weeks were spent at Colby, Kans., studying the question of quality and what could be done to improve it on the part of the farmer and the creamery management. Colby is situated in northwest Kansas, and is in a very good dairy community. By this is meant that the farmers are all more or less interested in the business and are milking. The first farm separator in this region was bought not over a year previous to the date of investigation, and the last milk was taken in during the month of the investigation, the station then becoming a cream-receiving point. The equipment, which was similar to that of all western milk-separating stations, consisted of a 12-horsepower upright boiler, an 8-horsepower horizontal engine, a power (belt) separator, and pumps, vats, and testing apparatus. In changing from a milk station to a cream station the separator was stored away and an outfit was put in for pasteurizing the cream. The milk tanks were used for cooling tanks to hold the cream cans until time for shipment. The engine had to be run to pump water and operate the pasteurizer. In common with most western stations, this one was too small to do the work properly. There was not sufficient tank room for keeping the cream cool nor for storing cans. The place was like a great majority of stations in being dirty and ill-kept.

^aThe proposition here made and recommended for carrying cream from the farm to the shipping station only once in two or three days may do for the peculiar conditions existing in the region specially under consideration—the formative stage of dairying recently introduced in a new country. But it will not do to let this stand as permanent advice. For best results there is no doubt that cream should be sent from the farm to the churn with the least possible delay. Daily delivery and shipment of cream should be the aim. How this is to be accomplished, especially where quantities are small and on scattered farms, and is a question which must be worked out by local conditions. It may be done by cooperative effort among farmers, by a carrier paid by them, by a gatherer employed by the creamery, or in some other way. The matter should not be considered as settled right, however, by the owner of the cows or the buyer of the cream until deliveries of cream at the creamery or the shipping station are as frequent and as regular throughout the year as were the former deliveries of milk.—H. E. A.

This description is given in order to show the kind of material often found, and this station was selected for investigation because of its large patronage, its location in the dairy region of the West, and because it was nearly 300 miles from the creamery plant to which the cream was sent and where it was churned.

During the time of the work at this station the farmers were in the midst of one of the greatest wheat harvests ever known in western Kansas or Nebraska; the weather was the hottest of the summer, and altogether the conditions for getting a good quality of cream were as unfavorable as they could be. The first work attempted after cleaning up the station was to ascertain the condition of the farmers' cream when delivered at the station. An acid test was made of every can of cream received for two weeks, and notes on its general quality were taken. It was found that the acid test was the best indication of its general quality. Cream that was delivered sweet was in nearly every case of fine flavor, while that delivered sour was often of very poor flavor. There were occasional exceptions to this rule, but the two ran much more closely together than was anticipated at the start. The following table gives much that is of interest to the dairyman and to the creamery man. The patron's number is given in the first column. The figures appearing under the date numbers are the readings as taken from Mann's acid test, each number representing the number of cubic centimeters of tenth normal alkali necessary to neutralize the acid in 50 cubic centimeters of cream. The arrangement of the table shows the number of deliveries made in two weeks and the number of cans in each delivery. One number indicates that one can was delivered by a patron on that date, two numbers indicate the delivery of two cans by the same patron, and three numbers three cans. This station was open for receiving cream every day except Sunday. This part of the work was begun on Monday, July 20, 1903, and was closed Saturday, August 1.

TABLE I.—*Data relating to deliveries of cream and results of tests at Colby, Kans., July 20 to August 1, 1903.*

Patron's number.	Results of acidity tests made of cream delivered on—											
	July 20.	July 21.	July 22.	July 23.	July 24.	July 25.	July 27.	July 28.	July 29.	July 30.	July 31.	Aug. 1.
1 ^a	{17.5	.....	10.2	.....	9.8	.....	11.7	.....	7.9	.....	18.5	12.2
	{34.0	.....	29.4	.....	26.6	.....	.....	.....	25.6	.....	.....	.....
2.....	{10.0	3.0	8.8	9.6	10.2	10.2	26.1	9.2	8.8	7.8	.....	14.6
	{21.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3.....	23.2	.....	27.7	.....	22.2	26.0	24.5	.....	21.3	.....	22.8	9.2
4.....	21.6	.....	27.0	.....	32.0	16.2	21.8	.....	26.2	.....	20.7	9.7
5.....	26.0	.....	.....	28.0	.....	26.4	25.2	.....	25.6	.....	.....	22.0
6.....	{9.2	3.0	9.6	9.6	13.3	9.4	17.0	10.3	8.8	9.1	.....	11.9
	{30.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

^aWhen the brace is used it indicates that the patron delivered more than one can at a time on one or more of the dates.

TABLE I.—Data relating to deliveries of cream and results of tests at Colby, Kans., July 20 to August 1, 1903—Continued.

Patron's number.	Results of acidity tests made of cream delivered on—											
	July 20.	July 21.	July 22.	July 23.	July 24.	July 25.	July 27.	July 28.	July 29.	July 30.	July 31.	Aug. 1.
7				22.7						8.2		
				22.9		19.2						
				32.8						23.5		
8	32.4		31.0		22.5	11.8	19.4		13.6		18.7	9.8
9	9.2		17.0		11.2	8.5	12.4		11.4	7.1	6.3	7.8
10	25.0		26.2		27.4	19.0	17.7		21.0		24.0	8.0
11		24.1		27.5		27.8		26.6		26.2		10.9
12	11.4		10.2		13.0	7.1	14.5		7.6		15.6	5.6
	30.0		30.0									6.0
13	12.2		8.8		14.0	9.9	10.8		7.7		7.4	9.6
	34.5		35.0		32.4		30.7		27.0		13.6	
14	24.5		20.8		20.0	9.4	12.8		18.5		14.5	
15	19.0		20.6		13.2	8.8	11.7		16.1		19.3	9.3
16	31.5		29.0		27.3	12.9			27.0		25.3	8.9
17	28.3	4.5	10.7	13.2	10.8		24.2	7.4	7.1		17.0	7.4
	9.3		9.2			9.6	8.6		7.9			
18	11.0		9.7	9.0		27.2	25.0		11.7			7.5
	28.4		30.5						28.5			
19	21.8			21.9		21.8	21.2		20.5			19.3
20	9.0	6.5	8.4	9.6	8.0	8.7	8.0	8.7	7.1	7.9	7.7	8.5
	26.0						25.3					
21	23.6	14.0	19.2	16.3	14.2	15.2	16.0	17.7	14.8		15.0	10.0
22			7.5			8.7	8.0		7.3			
	20.0		29.5		16.5		26.3		27.3		20.7	14.3
23	10.0	5.0	7.5	8.1	7.7	16.0	8.3	6.5	8.1	6.9	6.1	7.2
24	22.8	4.5	7.6	9.5	9.2	8.4	9.2	8.6	7.6		6.5	8.5
25	14.0		14.6			16.5	15.0		11.6			16.6
26	17.5		27.5		16.4	14.6	14.6		13.9		14.2	17.5
27	21.0		16.2		18.0		20.2		12.8		12.5	
28	11.5	6.0	5.8	6.0	5.0	6.4	11.2	6.5	5.4	6.2	5.7	5.4
29		22.8	16.7				31.5	27.5		21.0		15.0
		34.6										
30	10.0	10.0	9.5	8.9	10.2	14.0	11.0	9.0	11.7		19.6	6.9
31	16.5		12.7		19.3	10.5	25.0			21.0		10.8
32		26.0		23.3		25.7		21.2			23.9	
33		30.5		38.9		27.6		26.3		23.3		27.5
34	28.2	9.7	12.2	10.7	15.1	23.5	26.0	11.7	17.5		9.1	11.8
35	26.7		22.5			25.7	23.5		17.1			13.0
36	7.5	7.6	9.2	8.3	8.5	8.2	6.9	7.1	26.2	8.3		9.5
37	34.0		30.5		31.8	16.2	28.5		15.0		26.2	7.7
38			8.3		8.8						8.3	
			34.0		17.4						29.0	
39	25.5		23.5	18.7		27.9	30.0		30.3			22.6
40	9.3	3.5	7.9	9.0	10.0	11.0	10.6	10.5	8.5	12.7	8.5	8.8
	34.8						35.0					
41				9.7								
	9.0			23.0		6.5	13.9		8.8			9.4
	27.5			34.7								
42	28.5		28.1		27.2	8.8	18.5		17.1		18.7	
43	29.2	11.0	8.9		28.3	10.0	26.0		27.3		18.5	10.2
44	24.0		11.9				10.7			6.9		21.2
45	21.4			29.6		19.2	9.5		20.8			15.8

TABLE I.—Data relating to deliveries of cream and results of tests at Colby, Kans., July 20 to August 1, 1903—Continued.

Patron's number.	Results of acidity tests made of cream delivered on—											Aug. 1.
	July 20.	July 21.	July 22.	July 23.	July 24.	July 25.	July 27.	July 28.	July 29.	July 30.	July 31.	
46	25.4	.....	.....	.....	.....	15.2	.....	.....	30.0	10.7	.....	21.6
47	29.8	.....	20.3	.....	27.7	11.2	26.0	.....	.....	.....	24.2	12.5
48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	23.3	.....	28.2	.....	27.0	12.7	22.2	.....	20.5	.....	.....	26.0
50	.....	27.2	.....	.....	30.1	.....	.....	.....	.....	.....	.....	.....
51	16.6	.....	12.8	.....	15.2	8.8	9.7	.....	15.6	.....	12.8	.....
52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
53	32.8	.....	27.5	.....	25.2	20.0	25.4	.....	21.3	.....	10.4	7.3
54	.....	27.4	.....	25.1	.....	.....	.....	.....	.....	.....	21.6	.....
55	16.6	2.9	.....	.....	9.1	8.3	.....	.....	.....	21.3	.....	8.9
56	.....	.....	.....	.....	17.0	.....	.....	.....	.....	.....	.....	.....
56	10.5	.....	25.5	.....	25.6	10.3	17.5	.....	18.5	.....	12.4	8.9
57	20.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.7
58	23.2	.....	.....	.....	.....	22.5	19.6	.....	.....	.....	.....	.....
59	.....	.....	.....	.....	.....	36.2	.....	.....	.....	.....	30.7	.....
59	35.2	.....	37.0	.....	.....	37.5	.....	38.3	.....	.....	23.9	.....
60	8.0	8.5	7.6	8.5	9.5	8.9	.....	8.2	7.6	.....	16.3	9.4
61	18.5	.....	20.2	.....	21.8	10.3	19.4	.....	.....	.....	.....	16.4
62	.....	.....	.....	.....	.....	15.7	.....	.....	.....	.....	.....	.....
62	24.4	17.1	22.7	15.5	20.6	20.5	29.7	14.5	11.4	17.9	9.5	11.1
63	31.8	24.1	.....	23.6	.....	21.5	.....	22.2	.....	.....	.....	21.7
64	24.0	.....	25.8	.....	24.3	17.8	24.2	.....	21.3	.....	22.7	11.0
65	.....	.....	.....	.....	.....	4.5	8.5	.....	.....	.....	.....	.....
66	.....	.....	.....	.....	.....	10.6	24.9	.....	27.3	.....	.....	.....
67	.....	.....	.....	.....	.....	.....	24.5	.....	29.0	.....	.....	28.6
68	.....	.....	.....	.....	.....	.....	.....	29.8	.....	30.5	.....	14.7

A study of the above table with a view to getting averages shows some interesting things. For convenience of discussion the milkings before delivery will be numbered as follows: The milking of the morning on which delivery is made will be No. 1; the milking of the evening just previous to this will be No. 2; the milking of the morning before the day of delivery will be No. 3; that of the evening before this, No. 4, etc.

Taking the results of all tests known to represent milkings No. 1 or Nos. 1 and 2 mixed, the average degree of acidity is 9.3 for 226 such lots. Taking the cans that might contain Nos. 1, 2, 3, and 4, or Nos. 2, 3, and 4, or Nos. 3 and 4 the average degree of acidity is 22.1 for 260 such lots. Taking the cans supposed to contain milkings Nos. 3, 4, 5, and 6, or Nos. 4, 5, and 6, or Nos. 5 and 6 the average degree of acidity is 29.5 for 25 such lots. Of the class first mentioned 33 out of 226 cans contained enough acid to justify classing them as sour cream—that is, 14 or above. In the second class, 33 out of 260 cans contained less than 14 of acid and would have been classed as sweet cream. In

the third class all were sour. Putting these facts in the form of a table, the following is the result:

TABLE II.—*Showing number of sweet and sour cans delivered.*

Class.	Number of cans.	Sour.	Sweet.	Average acidity.
1.....	226	33	193	9.3
2.....	260	227	33	22.1
3.....	25	25	0	29.5
Total.....	511	285	226	.....

There was a great variation in the size of the cans used. One-gallon pails, 3-gallon pails, 5-gallon cans, 8-gallon cans, and 10-gallon cans were used in the delivery. The total quantity of cream received per week was between 1,100 and 1,200 gallons. Of the total received in the two weeks, from 30 to 50 per cent each day was sweet. This varied considerably with the days, Mondays showing the most sour cream and Saturdays the most sweet cream. Taking the total for each week's receipts, the sweet cream averaged about 33½ per cent. A study of Table I will show that the cream of the last week was not so sour as that of the first, and that the last two or three days showed the best results of all. It is interesting to note the temperature of these days and its evident effect on cream. Table III shows the maximum and minimum temperatures for each day covered by Table I, the average for the month of July, and the average during July for the ten years previous. This data is taken from the records at Colby made for the United States Department of Agriculture. The average acidity of the day's receipts of cream is also given.

TABLE III.—*Showing maximum and minimum temperatures, and acidity of cream.*

	Temperature.		Average acidity of cream.
	Maximum.	Minimum.	
July 20.....	100	56	21.3
July 21.....	96	61	13.5
July 22.....	98	65	18.6
July 23.....	93	65	17.8
July 24.....	94	65	18.1
July 25.....	97	61	15.5
July 27.....	95	61	18.7
July 28.....	98	58	14.1
July 29.....	91	54	16.7
July 30.....	77	58	14.5
July 31.....	62	52	16.5
August 1.....	77	55	12.4
Average, July, 1903.....	90.4	59.7	.....
Average, July, 10 years.....	90.9	59.2	.....

It must be understood in studying these figures that they are only approximations of the average acidity. The figures in Table I show

the exact acidity of each can delivered, but the weight of cream is not recorded. The results, so far as acidity is concerned, are therefore averages of Table I and can not be taken to mean more than that. They do, however, in a general way give the truth of the matter and show the tendency as influenced by the various factors given. For instance, in Table III the maximum temperature on the 20th was 100° and the degree of acidity 21.3; on the 27th the maximum was 95° and the acidity 18.7; on the 21st it reached 96° but the acidity was only 13.5, and on the 28th the highest temperature was 98° and the acidity 14.1. This shows simply that the factor of temperature has considerable influence on the acidity of the cream.

Another thing must be taken into account in the study of these figures: Not one in ten farmers had any good way to keep his cream sweet, and the weather showed its influence more than it would have done had every farmer owned a good tank and a mill pumping cold water about the cans all the time. The average temperatures for the first week in the above table are above the average for the Julys of the ten previous years, while for the last week they are below this average. Nearly an inch of rain fell on the 30th of July, which accounted for the cool weather of that day and the day following. The cream received on these days was in excellent condition, over 50 per cent of it being perfectly sweet.

A further study of Table I will show that a few patrons delivered sweet cream when coming every other day. These few were those who had a place fixed for holding their cream so that they could cool it quickly and hold it cool until delivered. The average well-water temperature of the vicinity of Colby is about 60°, and cream held at this temperature was delivered sweet 48 hours old. What these few did every man could have done, for all had the same sunshine and shade, the same winds and water—in fact, the same natural conditions—which are remarkably uniform in this western country.

Table I shows also the irregular methods which are followed in the delivery of cream, many seeming to have no regular time, while a few are as regular as the days of the week. This condition exists all over the territory under discussion, the delivery of cream being made a matter of convenience to the farmer rather than a necessity on account of the cream.

V. THE CREAMERY SIDE OF THE SUBJECT.

THE CREAMERY'S RESPONSIBILITY.

Thus far the discussion of this question of quality has been from the farmer's standpoint. The recommendations given in the first part of this bulletin for the handling and care of cream result from the experience gained at the Colby station while conducting the investigations there, from experience in other parts of Kansas and Nebraska, and from observation and consultation with men in the field who

are well informed on its conditions. The conditions at Colby are much the same as elsewhere. The farmer needs facilities for doing his work and needs the incentive to do it right. All of the cream at this point brought the farmer the same price, no matter what its condition. The patron who would take pains to furnish good cream saw it dumped into the same receptacle with other cream that he knew was inferior in quality. Under this condition—and it was the universal condition at least up to January 1, 1904—there was but little use for the creamery companies to talk about quality to the farmer. The object lesson of the stations and the system of buying cream was all against quality, and yet the creamery man who did not lay all of his troubles on the farmer was the exception. The creamery companies were doing, in a way, what they could to get good cream, and they spent more time on the farmer than they did on that part of the business that was in their own hands. The creamery men are not to be blamed too much, perhaps, for this condition, but to a certain extent they are at fault.

As was pointed out in the first part of this work, the creamery men fought the introduction of the farm separator until they had to give in. They put in time arguing that the separator on the farm would be a bad thing, instead of going to the heart of the question and making a study of the new conditions brought about by the farm machine. When the quality of butter “went off,” as it did, a sort of “I told you so” feeling was expressed by the creamery men to the dairy editor and even to the dairy-school worker. All were busy telling the bad things the separator would do, but none could offer anything, or seemingly tried to offer anything, that would help the bad condition, except to pitch into the farmer, first, because he bought a machine, and then because he furnished cream that was making bad butter. This was, perhaps, natural; it was easy, at any rate, because the farmer bought the machine under protest. When the creamery men first turned their attention to the matter and found that they had to sell machines or quit the business, they did what could not be helped under existing conditions—they put scores of agents into the field, and the order was “sell machines.” The result was, to put it in the language of the superintendent of one of the large creameries, that “in the transition from the whole milk to the hand separator business, in spite of the fact that we urged the delivery of cream at the station with sufficient frequency to insure good cream, the business, in a sense, has gotten away from us.” As before stated, neither the farmer nor the creamery man was ready for the change; neither understood the conditions that would arise under the change; and so far the farmer has received most of the blame. Let him take home all that is due him, but let the creamery operator learn that the poor butter has resulted as much from his lack of facilities and knowl-

edge of how best to handle the cream when it came into his care as from the farmer's shortcomings.

The past few months have shown some great advancement on the part of the creameries in this respect. The whole subject is studied as never before. New ideas are put into practice and new methods are used in the factories. Much of this is in the experimental stage as yet and needs time to develop its worth. From some quarters have come remarks deprecating any effort on the part of the creamery to improve the quality of the cream after it has once deteriorated in value. Theoretically this may be all right; the cream ought not to need improving, but the creamery that tries to improve the quality will find its own shortcomings more quickly and will learn that the farmer should not bear all the blame. Let the effort to improve all along the line go on; there is surely great need for it.

CLEANLINESS OF STATIONS.

Too much stress can not be laid upon cleanliness, which has already been mentioned several times. A dirty station or factory is no more excusable than a dirty farm separator. One is just as responsible for the poor quality of product as the other. Indeed, uncleanness at a receiving station has a wider influence for evil than on a single farm; a dirty station may undo the work of a number of clean farms. Station men, as a class, are paid about as well as school-teachers, railroad station agents, or telegraph operators. The prevailing practice is to pay them a commission for what business they handle. This, no doubt, makes them hustle for more business, but some evil effects go along with it. In the first place, these men are not trained in the creamery business. They do not know the value of cleanly methods and premises. This point has not been urged strongly enough on them by those superintending their work. They do not feel the necessity of spending enough time to keep things clean, but feel rather that when they have secured business their responsibility ceases. This is a matter that needs the careful attention of creamery managers all over the territory under discussion.

THE CREAM-PASTEURIZING STATION.

In the handling of the cream between the farmer and the creamery there are four general methods in use: (1) By a cream-pasteurizing station; (2) by a cream station without pasteurizing; (3) by handling cream through a store; (4) by direct shipment.

During the year 1903 there were but two companies west of the Missouri River handling their business by the first of these methods. It was fortunately one of these that received the cream from Colby, Kans., and this afforded an opportunity for the investigations carried on at that point to include considerable work along the line of pasteurizing sweet and sour cream for shipment and noting the result on quality. Much information was gathered, but owing to the many

things to be taken into consideration not many conclusions could be drawn from this work.

THE CREAM STATION WITHOUT PASTEURIZING.

All that has been said about cleanliness and care in the work of the pasteurizing station applies to the simple receiving station. The receiving station must have some method for making steam or boiling water, because steam or boiling water is absolutely essential for keeping things clean. Scores of such stations visited had nothing better for this purpose than a small gasoline stove. One company recently equipped a large number of this kind of stations with small feed-cooker boilers, which ought to answer the purpose very well. In managing this kind of a station, the cream should be graded, the best being put into cans by itself, and the poorer grades each by itself. It will all have about the same acidity when it arrives at the factory, but often cream that is sour when delivered at the station has already developed some other things besides acidity which are worse for the general quality of the butter than the fact that the cream is sour. Owing to this fact the cream should be just as carefully graded as in the pasteurizing station. The effect of shipment on unpasteurized cream in the development of acidity and on its score will be shown further on (pages 37 and 38).

HANDLING CREAM THROUGH A STORE.

At present this is the abomination of the creamery business. Under the present system it has nothing to commend it, but everything to condemn it. The storekeeper has neither the time nor the inclination to give the business the attention required. If he goes into it at all, it is to get trade; therefore he dare not refuse bad cream. He dare not offend a patron in any way. He is at the entire mercy of the patron, just as he has been for years in buying country butter. He has to take what is offered, be it good or bad, or lose a customer. If he uses the cream business as a means of advertising, he is apt to run the price of butter fat up to a fictitious value, thus creating a false impression of the business. He is rarely equipped with facilities of any kind for doing the business properly. In fact, he is a pirate, destroying other men's business for the sake of getting a little advertising for himself, and finally, becoming disgusted with the whole thing, he drops it, leaving the territory in which his injudicious operations were performed in a chaotic state, and causing some legitimate creamery men much expense in again putting the business on a sure and solid footing. If cream were not of so perishable a nature and the storekeeper could handle it as he does potatoes or apples, it might be a different matter.

The result of the store operation will be to destroy itself. Markets can not be found long that will pay a price for the inferior goods offered. With the market gone and the competitor next to him in the shape of a creamery man paying good prices for good cream, the life

of a storekeeper in the business will be of few days and full of sorrow. There is a possibility of a merchant handling the cream as efficiently as a special agent of the creamery, but the chances are 99 in 100 against his doing so. An extended observation of several months has revealed very few such. In many instances the storekeeper was getting all of the poor cream, and was having a hard time to satisfy the parties to whom he sold. The storekeeper will pass as a transitory figure in the great change from whole milk to farm cream separators.

THE DIRECT SHIPPER.

So far as quality is concerned, the direct shipper never has an equal chance with his neighbor who delivers to a near-by station. The direct shipper must hold his cream until he has a full can—5, 8, or 10 gallons—or else the expense of shipping is greater and his profits are reduced. The man who milks a large number of cows and can ship a can every day, or every two days at most, can furnish his creamery with as good cream as anyone, but there are few of this kind of shippers in the West.

The creamery run on this plan seldom adds anything materially to the development of the dairy business, unless it be in new territory. It can dip in here and there and get quite a patronage from disgruntled individuals who are dissatisfied with their home creamery and will go anywhere for a change. It is not meant to speak disparagingly of anyone in the direct shipping business, but these statements are made because observations over two great dairy States show it to be a fact that the greater part of the patronage of this kind of factory is of this class. The quality of such cream during the hot weather—and this is about seven months of the year—is bound to be inferior to that handled through stations. The author can suggest no remedy for this unless it be to ship oftener, which is a financial impossibility in the working of the system. During the winter months the direct shipper is on a more nearly equal footing. There is a time in the development of new territory when the business can be conducted by direct shipping methods. This is when the patronage is too small to justify the operation of a cream-receiving station. In such instances—and there are a good many where the dairy business is extending in new territory—there is nothing to be said against the system so long as it remains in that stage of development. This does not imply that good cream can be so secured, but it means giving a market to those who would not in any other way have one. As soon as such territory is sufficiently developed the station system will give the best results to both farmer and creamery.

TRANSPORTATION OF CREAM.

In the present stage of the business the only refrigerator-car service furnished by the railroads is to the companies operating a sufficiently large number of stations along a line to make up a car of cream before

it reaches the factory. Without doubt, as the business develops and dairying becomes more and more of a regular occupation, it will become incumbent upon the railroads to run refrigerator express cars for the general dairy interests along their lines. No comparison can be made between the refrigerator service and shipping without refrigeration that is at all favorable to the latter. If cream is subjected to such heating as it gets in the ordinary express or baggage car, or in a box car, it responds by fermenting very rapidly, and the loss in quality is exceedingly great. Many of the so-called refrigerator cars in the service are but makeshifts. The doors open at every station to load from 20 to 100 cans of cream, and the car is rapidly warmed. There ought to be a center vestibule made so that it could be closed to the outside air when the refrigerator compartment was opened to admit the cream. Better service along this line, and much better facilities for cooling and keeping the cream cool at the stations, would do much toward securing a good quality of cream.

VI. EXPERIMENTS IN SHIPPING CREAM.

The following tables give the data of the experimental work in shipping cream from the Colby station to Topeka, Kans. The cream was received and graded at the station, part of it being pasteurized and part shipped raw. The tables will explain themselves so far as the data collected is concerned. The author did the work at the station and was assisted by Mr. C. E. Gray at the factory in Topeka.

SHIPMENTS OF PASTEURIZED AND UNPASTEURIZED CREAM.

All of the cans numbered from 1 to 115, inclusive, were shipped during the last few days in July. The results were very unsatisfactory, but the data are given for these shipments because there are a few facts brought out that had considerable bearing on the later work.

TABLE IV.—*Data relating to shipments of cream from Colby to Topeka, Kans., July 20 to 29, 1903.*

SHIPMENTS OF PASTEURIZED CREAM.

No. of can.	July—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		<i>Hours.</i>	<i>° F.</i>	<i>° F.</i>			<i>Per cent.</i>		
1.....	20	72	66	68	19.2	33.1	31.7	1	2
2.....	20	72	62	68	23.7	31.2	34.4	2	2b
3.....	20	72	70	68	23.0	36.1	35.5	1	2b
5.....	20	72	66	66	26.2	32.1	33.1	1	2b
6.....	20	72	78	68	9.0	37.5	31.2	1b	3a
7.....	21	72	64	60	9.7	33.4	34.2	1	2b
8.....	21	72	63	61	9.7	33.6	34.4	1	2b
9.....	21	72	63	62	9.7	31.6	35.6	1	2b
11.....	21	72	64	62	27.3	26.7	35.8	2	2c
12.....	22	72	62	63	10.5	36.0	31.8	1	2a
13.....	22	72	62	66	12.3	34.4	32.1	1	2c
14.....	22	72	62	63	25.6	34.2	32.1	2	3b
15.....	22	72	62	65	30.0	34.0	32.1	2	3c

TABLE IV.—*Data relating to shipments of cream from Colby to Topeka, Kans., July 20 to 29, 1903—Continued.*

SHIPMENTS OF PASTEURIZED CREAM—Continued.

No. of can.	July—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		<i>Hours.</i>	<i>° F.</i>	<i>° F.</i>			<i>Per cent.</i>		
16.....	24	32	72	70	13.2	13.5	36.2	1	1a
17.....	24	32	70	70	13.0	14.0	38.0	1	1a
18.....	24	32	70	70	14.8	15.8	37.0	1	2
19.....	24	32	70	70	17.0	17.0	37.6	2	2
20.....	24	32	72	70	16.2	16.5	37.4	2	2b
21.....	24	32	82	70	17.5	18.0	38.6	2	2
22.....	24	32	68	70	17.2	23.0	29.8	2	2b
23.....	24	32	76	70	18.6	18.6	30.7	2	2b
24.....	24	32	70	70	19.6	18.5	32.7	2	2c
25.....	24	32	68	70	19.3	16.8	30.9	2	2
26.....	24	32	62	70	18.3	17.5	32.6	2	2
27.....	24	32	62	70	18.6	18.0	33.6	2	2
28.....	24	32	70	70	18.2	18.2	32.1	2	2
29.....	24	32	72	70	24.2	22.2	32.0	3	2
30.....	24	32	72	70	27.6	23.5	34.6	3	3
31.....	24	32	72	70	28.7	24.0	35.0	3	2
32.....	24	32	70	70	29.5	26.0	34.6	3	2
33.....	24	32	68	70	29.7	24.0	34.6	3	2
34.....	25	58	66	66	12.2	30.0	34.8	1	2
35.....	25	58	66	72	10.8	36.4	32.2	1	3
36.....	25	58	66	66	9.7	31.5	35.5	1	3
37.....	25	58	67	72	10.5	31.5	36.6	1	3
38.....	25	58	68	72	9.0	37.0	32.8	1	3
39.....	25	58	77	72	8.4	33.8	35.0	1	3
40.....	25	58	68	72	10.3	37.5	33.4	1	3
41.....	25	58	74	72	11.1	35.7	31.8	1	3
42.....	25	58	74	72	14.2	39.9	32.0	1	3
43.....	25	58	72	72	14.0	31.3	32.3	1	3
44.....	25	58	68	72	14.2	31.8	31.8	1	3
45.....	25	58	72	72	14.7	33.6	32.8	1	3
46.....	25	58	73	66	23.3	24.2	34.6	3	3
47.....	25	58	72	72	26.4	35.5	35.7	3	3
48.....	25	58	74	72	26.2	31.0	35.3	3	3
49.....	25	58	73	64	26.0	35.8	29.0	3	3
50.....	25	58	71	64	26.2	28.0	35.1	3	3
51.....	25	58	74	72	26.4	31.0	33.6	3	3
52.....	25	58	76	65	26.0	30.8	33.8	3	3
53.....	25	58	70	66	26.2	30.0	36.2	3	3
54.....	25	58	71	72	26.2	32.0	34.4	3	3
55.....	27	34	66	76	11.6	20.0	37.0	1	2c
57.....	27	34	66	76	11.1	24.0	35.0	1	2c
59.....	27	34	65	76	11.2	22.0	34.6	1	2b
61.....	27	34	66	76	10.0	25.0	33.8	1	2c
63.....	27	34	74	76	10.0	36.0	32.7	1	3
65.....	27	34	68	76	10.6	27.0	34.0	1b	2c
67.....	27	34	66	76	18.7	36.0	34.5	2	3
69.....	27	34	68	76	23.7	28.0	33.6	3	2c
71.....	27	34	66	76	25.1	22.0	32.2	3	2c
73.....	27	34	66	76	24.9	24.0	31.5	3	2c
75.....	27	34	66	76	25.9	25.0	28.1	3	3
77.....	27	34	71	76	26.0	25.0	32.2	3	2c
79.....	27	34	71	76	25.4	28.0	32.3	3	2a
81.....	27	34	76	76	23.2	27.0	21.5	3	3

TABLE IV.—Data relating to shipments of cream from Colby to Topeka, Kans., July 20 to 29, 1903—Continued.

SHIPMENTS OF PASTEURIZED CREAM—Continued.

No. of can.	July—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		Hours.	° F.	° F.			Per cent.		
82.....	27	34	76	76	13.9	30.0	36.3	3	3
83.....	28	34	66	72	9.8	23.6	32.0	1	2a
85.....	28	34	68	72	9.4	20.5	34.7	1	2a
87.....	28	34	74	72	26.2	25.0	30.7	3	2b
89.....	28	34	70	72	27.9	33.0	33.2	3	2b
91.....	29	34	64	66	7.4	11.5	29.2	1	2a
92.....	29	34	64	66	7.7	8.0	35.6	1	2b
93.....	29	34	67	66	8.4	9.0	36.5	1	2b
94.....	29	34	68	66	8.2	9.0	36.8	1	2c
95.....	29	34	66	66	8.3	9.0	35.8	1	2a
96.....	29	34	66	66	8.4	10.0	35.8	1	2a
97.....	29	34	70	66	8.9	10.5	34.8	1	2b
98.....	29	34	66	66	10.5	12.0	33.0	1	2
99.....	29	34	66	66	13.5	12.0	32.6	1	2
100.....	29	34	75	66	14.2	14.2	30.4	1b	2b
101.....	29	34	70	66	15.5	14.0	31.4	2	2b
102.....	29	34	66	66	19.5	17.5	31.6	2	2a
103.....	29	34	67	66	25.3	35.0	32.4	3	2a
105.....	29	34	69	66	27.8	24.5	33.0	2b	2b
107.....	29	34	68	66	28.1	27.0	32.8	3	2b
109.....	29	34	64	66	27.9	25.0	32.8	3	2c
111.....	29	34	68	66	27.3	24.0	32.0	3	2b
113.....	29	34	70	66	27.0	24.0	30.4	3	2c
115.....	29	34	70	66	8.8	25.5	40.6	1	2a

SHIPMENTS OF RAW CREAM.

No. of can.	July—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		Hours.	° F.	° F.			Per cent.		
4.....	20	72	78	68	27.6	40.7	31.6	2	4a
10.....	21	72	82	62	29.0	38.6	32.4	2	3
56.....	27	34	72	76	13.1	32.0	37.5	1	2
58.....	27	34	70	76	12.1	32.0	36.8	1	3
60.....	27	34	75	76	14.1	34.0	33.2	1b	2
62.....	27	34	74	76	11.6	34.0	34.8	1	2b
64.....	27	34	74	76	11.5	33.0	34.0	1	2b
66.....	27	34	73	76	24.3	37.0	33.0	2	2b
68.....	27	34	74	76	22.5	42.0	33.8	2b	3
70.....	27	34	76	76	24.2	37.0	32.8	2b	3
72.....	27	34	78	76	25.9	38.0	33.0	2b	3a
74.....	27	34	77	76	26.5	42.0	32.8	2b	3
76.....	27	34	78	76	25.7	39.0	32.2	1b	2c
78.....	27	34	78	76	25.7	41.0	32.1	2	3
80.....	27	34	79	76	25.7	39.0	32.4	2b	3
81.....	28	34	74	64	9.8	32.0	34.4	1	2c
86.....	28	34	76	64	8.5	32.0	36.0	1	2c
88.....	28	34	80	64	26.0	34.0	35.4	2b	2c
90.....	28	34	84	64	28.9	47.5	32.8	3	3d
104.....	29	34	77	66	26.3	32.0	31.2	2	2b
106.....	29	34	74	66	28.9	26.0	33.0	3	3b
108.....	29	34	76	66	27.2	34.5	30.0	3	3
110.....	29	34	76	66	27.0	36.0	30.4	3	3
112.....	29	34	78	66	27.2	35.0	30.0	3	2c
114.....	29	34	78	66	30.3	37.0	36.6	3b	3a

The following explanations will be necessary for a clear understanding of the preceding table. The cans were numbered from 1 consecutively throughout the entire investigation, these numbers appearing in the first column. The date on which the cream was received at the station appears in the second column. The column headed "Time on road" indicates the number of hours between the receipt of the cream at the station and its arrival at the factory. The temperature was taken and the acid test was made at the station as the cream came from the pasteurizer, or, in the case of raw cream, as it was poured into the cans for shipment. The temperature was again taken and the acidity test was repeated on arrival at the factory. The cream was graded at the station and at the factory on the following basis:

Grade 1 represented cream that would score 96 points on a scale of 100 for perfection, or, in other words, cream that would be expected to make butter that would score 96; grade 2 represented cream that would score 92; grade 3, that which would score 88; and grade 4, that which would score 84. The letters "a," "b," and "c" were used for the intervening grades between 96, 92, 88, and 84, "a" representing 1 point less, "b" 2 points less, and "c" 3 points less. Thus "1a" would mean 95, "1b" 94, and "1c" 93. The grading was done by two different persons nearly three hundred miles apart, and it took some time to get this part of the work uniform. It is owing to this and to the fact that much of the cream was three days on the road that no definite conclusion can be drawn from this set of figures.

Cans Nos. 116 to 258, inclusive, were shipped August 17-31. During this period the railroad facilities were better than at the time of the first shipments, and a few things were avoided which then caused irregular work. The data given in Table V are in the same order as in Table IV. A change in the method of making the acid test was made. The tests in Table IV were made with a 50-c. c. pipette, while those in the following tables were made by weighing 18 grams of cream into the cup. The weighing was made necessary from the fact that the pipette would not give a full measure when the cream was taken immediately after going through the pasteurizer and cooler, nor at the factory, where the cream would in many instances have more or less gas in it. Weighing the sample and calculating the result to 50 c. c. gave more uniform results. The grading in the tables following was also much more uniform and satisfactory.

TABLE V.—*Data relating to shipments of pasteurized cream, one day on the road, from Colby to Topeka, Kans., August 17-28, 1903.*

No. of can.	August —	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		Hours.	° F.	° F.			Per cent.		
116.....	17	23	66	74	12.0	15.7	33.0	1	1a
117.....	17	23	64	74	13.4	15.4	32.0	1	2a
120.....	17	23	66	74	14.2	16.6	32.8	1b	2b
122.....	17	23	67	74	14.8	15.2	33.4	1	2b
125.....	17	23	68	74	13.1	14.7	38.8	1	2
127.....	17	23	88	74	15.1	24.4	37.8	1	2
141.....	18	24	70	78	7.8	29.1	37.6	1	3a
142.....	18	24	70	78	7.8	29.9	34.2	1	3a
145.....	18	24	72	80	7.2	29.4	41.2	1	3a
145b.....	19	23	68	75	9.8	35.0	34.0	1	3
146b.....	19	23	66	75	9.2	33.6	35.6	1	2b
147b.....	19	23	66	75	13.4	28.0	35.6	1	1b
148b.....	19	23	72	75	13.1	30.8	35.8	1	2
157.....	19	23	70	75	11.7	42.0	37.4	1	2
168.....	20	26	76	72	7.8	11.2	33.4	1	3
169.....	20	26	68	72	8.4	8.4	35.6	1	2
170.....	20	26	72	72	7.8	11.2	34.5	1	1c
172.....	20	26	82	72	6.7	19.6	42.6	1	2
173.....	20	26	74	72	7.0	18.2	39.2	1	2c
180.....	21	24	74	68	8.1	15.9	32.2	1	1c
181.....	21	24	74	68	9.5	11.2	32.0	1	1c
182.....	21	24	68	68	12.6	13.1	33.0	1	1b
185.....	21	24	68	68	13.1	13.7	31.4	1	1b
187.....	21	24	68	68	12.6	12.8	33.6	1	2a
188.....	21	24	72	70	11.7	12.3	34.9	1	1c
189.....	21	24	70	72	12.0	12.3	28.0	1	1c
191.....	21	24	68	68	12.6	13.4	26.7	1	1c
198.....	22	26	68	72	10.3	12.0	34.8	1	1b
199.....	22	26	68	72	9.8	12.0	34.4	1	2c
200.....	22	26	68	72	9.8	12.0	34.7	1	1b
201.....	22	26	74	72	10.7	33.0	36.4	1	1b
202.....	22	26	68	72	11.2	12.0	39.3	1	2a
203.....	22	26	68	72	10.6	11.0	35.5	1	3c
204.....	22	26	72	72	8.6	15.0	35.0	1	1c
207.....	22	26	72	72	8.9	29.0	36.4	1	2b
221.....	26	24	70	70	8.9	9.5	34.2	1	1b
222.....	26	24	72	70	9.8	11.2	33.6	1	1c
223.....	26	24	65	68	9.8	10.0	38.8	1	1c
225.....	26	24	68	68	10.0	10.6	34.5	1	1c
227.....	26	24	66	68	11.7	12.6	33.8	1	1c
229.....	26	24	70	70	14.0	15.4	37.8	1	2a
230.....	26	24	68	68	16.5	17.0	35.4	1	2a
231.....	27	24	74	68	9.5	11.2	33.5	1	2a
232.....	27	24	76	66	10.9	11.4	38.4	1	1c
233.....	27	24	68	66	10.9	10.9	38.5	1	1b
234.....	27	24	68	66	9.2	9.8	35.5	1	2a
235.....	28	24	65	64	6.7	7.0	33.8	1	1b
236.....	28	24	64	66	7.2	7.5	33.6	1	1b
237.....	28	24	64	64	9.5	9.8	36.8	1	1b
238.....	28	24	66	64	8.1	8.1	35.8	1	1b
239.....	28	24	64	64	8.9	9.2	35.8	1	1b
240.....	28	24	72	66	9.5	9.8	40.0	1	1c
241.....	28	24	70	64	7.8	7.8	40.0	1	1a
Average for 53 cans.....					10.2	16.1	35.3	95.97	91.96
Average for 18 cans, August 26-28.....					9.9	10.4	36.1	96.00	93.08

TABLE VI.—Data relating to shipments of pasteurized cream, two days on the road, from Colby to Topeka, Kans., August 17-22, 1903.

No. of can.	August—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		Hours.	° F.	° F.			Per cent.		
128.....	17	44	70	75	19.8	22.4	36.6	1c	2c
129.....	17	44	76	75	18.7	19.3	34.0	1c	2c
130.....	17	44	76	74	16.5	31.0	37.0	1c	2c
131.....	17	44	72	74	8.6	31.3	39.8	1	3a
146.....	18	44	67	75	7.2	29.4	35.6	1	2c
159.....	19	48	68	72	9.2	32.2	38.6	1	1b
160.....	19	48	68	72	8.9	32.2	36.4	1	2c
161.....	19	48	71	72	8.6	28.0	35.6	1	2b
162.....	19	48	73	72	17.9	30.8	34.2	1c	1c
163.....	19	48	74	72	10.9	29.4	27.8	1	2c
192.....	21	48	68	72	14.5	36.0	29.2	1a	2c
193.....	21	48	68	72	15.9	33.0	32.4	1a	2c
194.....	21	48	68	72	15.4	29.5	33.4	1a	2a
196.....	21	48	68	72	14.2	31.0	36.6	1a	2b
214.....	22	42	74	68	10.9	37.5	34.5	1	3a
215.....	22	42	70	68	12.0	33.6	34.5	1	3a
216.....	22	42	74	68	7.8	29.4	28.4	1	3b
217.....	22	42	76	68	6.4	34.4	35.4	1	4c
218.....	22	42	86	68	10.0	36.4	33.4	1	3a
Average for 19 cans.....					12.2	30.8	34.4	95.16	88.76

TABLE VII.—Data relating to shipments of unpasteurized cream, one day on the road, from Colby to Topeka, Kans., August 17-31, 1903.

No. of can.	August—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		Hours.	° F.	° F.			Per cent.		
118.....	17	23	64	74	25.5	31.6	33.8	1b	1b
119.....	17	23	68	74	23.0	32.7	39.6	1b	1b
121.....	17	23	68	74	28.9	38.2	32.2	2	2
123.....	17	23	68	74	26.1	35.5	31.4	2	3
124.....	17	23	75	74	25.2	34.0	41.8	1c	2c
126.....	17	23	74	74	22.1	29.8	39.0	1	2
140.....	18	24	74	77	20.7	37.2	43.4	1	2a
143.....	18	24	68	77	28.0	32.2	36.8	2a	2c
144.....	18	24	76	78	29.4	52.3	37.0	1b	4a
149.....	19	23	72	75	25.7	37.8	34.6	1b	2a
151.....	19	23	66	75	32.2	37.8	37.0	2	3
152.....	19	23	72	75	29.4	44.8	32.6	1b	4
153.....	19	23	72	75	27.1	39.2	35.0	1b	2a
154.....	19	23	74	75	28.5	42.0	35.4	1b	2
155.....	19	23	80	75	30.2	46.2	31.6	1b	3
156.....	19	23	76	75	24.6	37.8	32.6	1b	2a
158.....	19	23	72	75	25.4	37.8	32.8	1c	1c
171.....	20	26	76	72	21.5	26.6	39.2	1	2c
174.....	20	26	79	72	18.2	30.8	38.6	1	1c
183.....	21	24	75	74	24.3	31.6	39.4	1b	2a
184.....	21	24	76	74	27.1	36.9	31.0	2	2a
186.....	21	24	70	72	27.1	33.0	32.0	2c	2c
190.....	21	24	76	72	17.3	27.1	38.5	1c	2a
205.....	22	26	80	72	22.6	31.5	28.9	1b	2b
206.....	22	26	76	72	26.6	35.5	37.0	1a	2a
224.....	26	21	70	68	19.6	26.6	33.8	1b	2a
226.....	26	21	68	68	25.0	36.8	28.0	1c	2c
228.....	26	21	68	68	27.4	33.0	32.4	2b	2c
242.....	29	24	66	64	7.2	28.8	36.6	1	2b

TABLE VII.—Data relating to shipments of unpasteurized cream, one day on the road, from Colby to Topeka, Kans., August 17–31, 1903—Continued.

No. of can.	August—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		<i>Hours.</i>	<i>° F.</i>	<i>° F.</i>			<i>Per cent.</i>		
243.....	29	24	66	64	7.2	29.4	35.2	1	2b
244.....	29	24	66	64	7.2	28.5	36.4	1	2c
245.....	29	24	68	64	8.1	29.9	32.4	1	2b
246.....	29	24	70	64	16.8	32.4	37.0	1c	2a
247.....	29	24	68	64	8.1	29.4	37.9	1	2c
248.....	29	24	66	64	9.8	32.4	32.4	1	2c
249.....	29	24	66	64	22.4	33.0	29.7	2	3b
250.....	29	24	65	64	21.0	33.0	32.2	1c	2a
251.....	29	24	66	64	23.8	36.2	37.8	2	2a
252.....	31	22	67	64	10.0	29.9	35.6	1	2b
253.....	31	22	67	64	10.0	29.4	34.7	1	2b
254.....	31	22	67	64	10.0	29.0	34.2	1	2b
255.....	31	22	68	64	25.7	30.8	37.4	1c	2c
256.....	31	22	69	64	31.3	36.4	31.7	2a	2c
257.....	31	22	67	64	10.0	31.2	33.0	1	2c
258.....	31	22	67	64	9.5	29.1	36.4	1	2a
Averages for 45 cans.....					21.0	33.8	35.0	93.96	89.96
Average for 17 cans, August 29–31.....					14.0	31.1	34.7	94.72	89.68

TABLE VIII.—Data relating to shipments of unpasteurized cream, two days on the road, from Colby to Topeka, Kans., August 17–22, 1903.

No. of can.	August—	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity.	Butter fat.	Station grade.	Factory grade.
		<i>Hours.</i>	<i>° F.</i>	<i>° F.</i>			<i>Per cent.</i>		
132.....	17	44	66	74	22.6	28.5	34.0	2	3a
133.....	17	44	71	74	27.1	36.9	33.4	2	3b
134.....	17	44	71	76	20.7	31.6	35.0	1c	4a
135.....	17	44	70	74	26.8	36.9	32.0	2	3b
136.....	17	44	70	74	26.8	39.4	27.6	2	3a
137.....	17	44	68	74	21.2	30.5	36.4	2	3a
138.....	17	44	73	74	22.9	43.9	45.2	2	4a
139.....	17	44	68	74	29.4	41.1	28.4	3	3c
147.....	18	44	73	75	26.6	33.6	37.8	1a	2
148.....	18	44	70	75	26.8	47.6	35.6	1b	3b
143b.....	18	44	76	75	27.1	40.6	35.0	1c	3
144b.....	18	44	71	75	30.5	37.8	31.4	1c	2b
164.....	19	48	68	72	24.3	37.8	35.0	1	3
165.....	19	48	72	72	24.0	37.8	32.6	1a	3b
166.....	19	48	78	72	18.4	28.0	41.6	1b	2
167.....	19	48	78	68	27.4	40.6	34.4	1b	3
175.....	20	45	71	68	23.2	35.0	33.5	1a	2c
176.....	20	45	74	68	29.4	44.5	31.4	1b	4a
177.....	20	45	77	68	24.6	35.0	38.4	1c	3a
178.....	20	45	74	68	22.1	35.5	33.9	2	2b
179.....	20	45	68	68	22.4	30.2	37.4	2c	2b
195.....	21	48	74	72	25.4	34.5	38.5	1b	3c
197.....	21	48	74	72	23.8	35.5	36.0	1b	2b
208.....	22	42	82	68	28.5	46.4	36.0	1	4a
209.....	22	42	82	68	28.2	38.9	37.8	1	3a
210.....	22	42	82	68	28.0	45.6	36.0	2	3b
211.....	22	42	82	68	27.4	38.3	35.6	1c	3a
212.....	22	42	78	68	28.0	38.9	38.2	1	3b
213.....	22	42	82	68	29.4	43.9	39.2	1a	3b
219.....	22	42	82	68	24.9	35.2	36.9	1a	3a
220.....	22	42	72	68	55.2	65.8	29.2	4	4a
Average for 31 cans.....					26.5	38.5	35.2	92.02	86.88

A few general ideas can be derived from the above tables. The temperature of pasteurization varied from 170° to 180° and the cream was immediately cooled to the temperatures named under the heading "Station temperature." The Jensen pasteurizer and cooler was used.

A glance at the tables will show that the cream was divided into sweet and sour, the turning point being 14. All of the sweet cream was pasteurized and all of the sour cream shipped raw until August 29, when an accident befell the pasteurizer and all of the cream of the 29th and 31st was shipped raw.

EFFECT OF PASTEURIZING ON THE KEEPING QUALITIES OF SWEET CREAM.

Table V shows that cream testing an average of 10.21 of acidity when pasteurized was found on arrival at destination twenty-four hours later to have increased in acidity 5.93, so as to measure 16.14. Cream at this acidity is slightly sour. The average score at the station, on the basis of 100 as perfect, was 95.97, while at the factory it was 91.96. Comparing this with the cream that was two days in transit, as shown in Table VI, quite a difference will be noted. This cream started under conditions practically equal to those of the cream which was one day in transit. The degree of acidity at the station was 12.28, and on arrival at the factory forty-eight hours later it had increased 18.06 or to 30.88. The score had fallen from 95.16 to 88.76. The temperatures on arrival at the factory show that this difference was not due to that factor. The shipments were all made in refrigerated cars and the conditions were about equal in this respect. The difference between an acidity of 16.14, after being one day in transit, and an acidity of 30.88, after being two days in transit, is simply the result of time in developing the acid. During the first twenty-four hours but little develops, but during the next twenty-four hours the acid increases very fast.

The average for the cream shipped on August 26, 27, and 28, given under Table V, is interesting. An acidity of 9.93 at the station advanced only to 10.49 at the factory twenty-four hours later, with scores of 96 at the station and 93.08 at the factory. These lots were similar to those of preceding days, with the exception that the cans used in shipping were washed out with very strong lye water after the regular washing was given them and then rinsed with cold water before filling. The cans in the previous lots were washed with a common washing compound, and the work was not very well done. It will be noticed that the cream was much more uniform on arrival at the factory than any of that shipped on preceding days. This subject of can washing will be referred to again.

A reference to Table IV shows the same general results as those just mentioned. The pasteurized cream, whether sweet or sour, if not over thirty-four hours on the road, arrived at the factory in about the

same condition as regards acidity as when it left the station. It will also be seen that there is a limit to the formation of acid. Cans Nos. 1 to 15 in Table IV show cream shipped, some sweet and some sour, and the acidity on arrival, seventy-two hours later, is about the same for all, an average degree of acidity of about 34.

THE KEEPING QUALITY OF RAW CREAM SHIPPED.

Table VII shows that raw sour cream, with an acidity of 21 when shipped, on arrival at destination, twenty-four hours later, had increased to 33.8, or an increase of 12.8. The average score at the station was 93.96, while at the factory it was 89.96. Contrasting this with cream that was two days in transit, as shown in Table VIII, the difference is not found very marked, at least not so much so as in the case of the pasteurized cream. This cream started under conditions practically equal to those for cream one day on the road, the degree of acidity at the station being 26.5, and when it arrived at the factory, forty-eight hours later, it had increased 12, or to 38.5, showing about the same increase as that which was one day on the road. The average score on this cream was 92.02 at the station and 86.88 at the factory. This cream was shipped in refrigerator cars under exactly the same conditions as the pasteurized cream; in fact it was shipped along with the latter.

The average of cream shipped on August 29 and 31 is here as interesting as in the case of pasteurized cream. (See Table V.) This cream left the station with an average degree of acidity of 14, and arrived at the factory twenty-four hours later with an acidity of 31.1, the average score falling from 94.72 to 89.68. The same precautions in regard to cans were used in this case as on August 26, 27, and 28, as noted under "Pasteurized cream." For greater convenience in making comparisons, the following table is arranged to show the averages from Tables IV, V, VI, VII, and VIII:

TABLE IX.—Averages of data relating to cream shipped on July 27, as shown in Table IV, and of all data shown in Tables V-VIII on cream shipped from Colby to Topeka, Kans.

No. of table.	State of cream.	Time on road.	Butter fat.	Station acidity.	Factory acidity.	Station grade.	Factory grade.	Fall in grade.
		<i>Hours.</i>	<i>Per cent.</i>					
IV	Pasteurized	34	.....	24.10	25.60	88.52	88.88	a 0.36
IV	Raw	34	.....	25.00	39.30	91.00	88.16	2.84
V	Pasteurized	24	35.33	10.21	16.14	95.97	91.96	4.01
V	Pasteurized	24	36.10	9.93	10.49	96.00	93.08	2.92
VI	Pasteurized	48	34.40	12.28	30.88	95.16	88.76	6.40
VII	Raw	24	35.01	21.00	33.80	93.96	89.96	4.00
VII	Raw	24	34.74	14.00	31.10	94.72	89.68	5.04
VIII	Raw	48	35.27	26.50	38.50	92.02	86.88	5.14

a Rise.

In Table IX are first introduced for comparison averages of the data from Table IV, relating to cream shipped on July 27. On that date it was so arranged that every other can, as it ran from the receiving vat, should be pasteurized and the others should be shipped raw. This gave a direct comparison between raw and pasteurized sour cream where the cream was identical and all conditions alike except that of pasteurization. Unfortunately this is the only comparison of this kind from all the data given, but the example is a good one and is interesting. It will be seen that the eight cans that were pasteurized at the station scored there 88.52, as recorded in Table IV, while the same number of cans of unpasteurized cream scored 91. This difference was due to a peculiarly bitter or astringent flavor in the pasteurized sour cream that caused it to be scored down. This evidently did not show at the factory, as no comment was made there in regard to it, although it was looked for. It is interesting to note that the unpasteurized sour cream was scored on arrival at the station nearly as high as the pasteurized sour cream.

PASTEURIZING CREAM—GENERAL CONSIDERATIONS.

Does it pay to pasteurize sour cream at the station? A careful study of Table IX would indicate that it does not. The question as to whether it would pay to equip a station with a complete pasteurizing outfit for the purpose of pasteurizing sweet cream alone is an open one. It will depend largely on the amount of sweet cream the station will furnish and how well the work can be done at the station. The cost of pasteurizing must be taken into account and compared with the benefits derived. If the cost of equipping and maintaining a series of stations with pasteurizers is going to be greater than the sum derived from the advance in price of butter because of pasteurizing, it certainly will not pay. The data given in the tables, while very incomplete in many of the things that ought to be definitely known, may be a guide to some creamery company that wishes to experiment further along these lines. If so, it will be the greatest service to which they can be put.

There are a few things that the man operating a pasteurizing station must observe if he wants success in getting and keeping the quality of his product. Pasteurizing is performed for the purpose of destroying the germ life that the cream contains. This is done by heat. The heat is applied either by steam directly from the boiler or by exhaust steam from the engine, or it may be by the steam that runs the pasteurizer, as in turbine machines. In the continuous pasteurizers in use the temperature of the cream as it leaves the machine is usually between 160° and 190°. The higher the temperature the more thorough the work, for the more complete is the destruction of the germ life. Not all germ life is destroyed by pasteurizing. "Sterilizing" means the

complete destruction of all the germ life, but this is impracticable outside of a laboratory well equipped for doing such work. The success of pasteurization depends upon the following things: (1) Sufficient heat to destroy the greater portion of the germ life; (2) quick cooling, which also aids in the destruction of germ life or causes those germs not destroyed to lie in a dormant condition, and (3) thorough cleanliness of everything that comes in contact with the cream. The work is often rendered useless because the cream is again inoculated with the germs from a dirty can, a stirring rod, or a thermometer taken from cream not pasteurized and put into the pasteurized cream. Insufficient after-cooling of cream will also render pasteurization useless. One thing that must be observed, or the work will be a failure, is that everything which comes in contact with the cream after it is pasteurized must be clean.

In the experiments conducted at Colby one of the hardest things to overcome was the foul smell in the shipping cans. All ordinary means of washing seemed to fail in eradicating these odors, and cream from the same lot placed in different cans at the station would reach the factory in various stages of fermentation and presenting a variety of odors. It was not until the cans were rendered practically sterile by washing in strong concentrated-lye water that the difficulty was overcome. For the best results in pasteurizing, the cream should be delivered by the farmer in a perfectly sweet condition. The Western creameries have to some extent adopted methods to help along in this line.

VII. CREAM GRADING.

This is a subject that is new to the Western creamery man—too new for any results of actual practice to be given. The author of this bulletin recently recommended a system for grading cream at the stations, which has been adopted by one creamery company and will probably be adopted by many others in its entirety or in a modified form. The question of grading and buying on grade has been agitated for a long time, but there seemed to be obstacles in the way that had to be overcome. The right or wrong of the matter was never disputed. The lack of machinery for putting it into force and the difficulty of getting any concerted action on the part of the creameries stood in the way. It was thought by many that such a system would mean a lowering of the price from 1 to 2 cents a pound to the farmer and that he would look at it in that light and resent the move. A careful study of the situation and conversation with many farmers in different parts of the country showed that they, too, recognized the right and the necessity for a system which would put a premium on good cream rather than on bad cream.

The investigation of patrons' cream at Colby, as recorded in Table I, showed several possibilities not before taken into account. In the first place there are a few who can already furnish sweet cream from three to four times per week. Then there are a few who can deliver every day, and a much larger number who can at least furnish part of their cream sweet if told how. Patrons of this class come in three or four times a week, bringing all their cream in one can, all sour, and only fit for second grade. As previously stated, it may be impossible for these men to come any oftener. The case of a few of them furnishes a clew to a partial solution of the difficulty. It will be noticed that a few did not mix all their cream together, but brought it in two cans—one sour and one sweet. There might be four milkings in one and two in the other, or two milkings in each lot, so that one-third or one-half of their delivery would be sweet cream. It was also found that men delivering their cream in small cans usually had the best cream. Two gallons in a 10-gallon can might be sour, while the chances were much greater of its being sweet if delivered in a 3-gallon can. After careful study it was estimated that if all the farmers would keep their last two milkings separate and use small cans, fully half of the cream would be delivered to the creamery perfectly sweet. This simply means that if the farmer would expend a dollar or two for two or three more cans he could get the best prices for half of his cream, and would then have to take from 1 to 2 cents less for the other half. With this 1 or 2 cents difference acting as an inducement to improve along these lines, as suggested in the first part of this bulletin, he would soon be bringing three-fourths of all of his cream sweet. The coming year will, no doubt, demonstrate the advantage of this practice.

It is not thought that this change can be made all at once, but it will have to be a matter of growth on the part of those in the business. The thought of grading cream at once called for a dividing line. As has been observed the acidity of the cream has in the greater number of cases indicated its value quite closely, so closely in fact that it was thought feasible to do the grading on the basis of acidity. It was recommended to the creamery company already mentioned that it draw the dividing line at 15 by Mann's acid test, and that the station operator be supplied with an alkaline tablet, the strength of which would just neutralize an acidity of 5.25 in 17.5 c. c. of cream measured into a cup with the pipette. This recommendation has been adopted by the company, and on the 1st of January, 1904, their station operators began grading on that system. It is thought that after a little practice the test will not be needed except in case of dispute between the operator and patron as to the condition of the cream. The company makes a difference of 1 cent per pound between the two grades.

The following directions are quoted from a circular sent out by the company to its station operators for making the alkaline test:

Preparing test solution.—Place in a perfectly clean one-half pint sample jar one perfect tablet and with a milk pipette measure into the jar 17.6 c. c. of pure water, temperature between 40° and 120° F. Close the lid on the jar and allow the tablet to completely disappear in the solution. When entirely dissolved, with the exception of a few particles of inert material that may be seen, the solution is ready for use. Measure out in a pipette from the cream to be tested exactly 17.6 c. c. and run it into the tablet solution. Rinse all cream from the pipette by drawing the mixture already in the sample jar into the pipette and allowing the mixture to again flow into the jar. If, after mixing, the color remains pink, the cream is sweet enough to grade No. 1, but should the pink color disappear and the mixture become the color of the cream, the cream sample is sour and grades No. 2.

How to know the color.—Should any trouble be experienced in determining whether or not any color is present in the test (this will occur only when the acidity of the cream is very near the line between sweet and sour), it is advisable to take another sample jar, place in it 17.6 c. c. of cream, the same as is being tested, with 17.6 c. c. of water, but no tablet. Place the two jars side by side on a piece of plain white paper. Compare the two by looking down through the mouths of the sample jars toward the white paper underneath. By this method any pink color may be seen if present in the sample containing the tablet.

In no instance try to examine the color of a sample by looking through the side, but always through the mouth of a jar. Examine tests in good bright light, but not in direct sunlight.

Sample jars.—The operator should be provided with as many sample jars as daily tests are required. The jars should be thoroughly washed and rinsed before using, and great precaution should be taken to keep them free from acid, lye, or sal soda. The lids should be closed while the tablet is in the solution before using, thus preventing any material from falling into the jars.

Water.—The water for dissolving the tablets should be as pure as it is possible to obtain. Endeavor to secure enough condensed steam for this water supply. If water from condensed steam can not be had, then use clean rain water or melted ice.

Should it be necessary to use water from a well or spring, the water should in every instance be boiled. The water supply for use in this test should be kept in a clean, tightly corked bottle or sealed glass fruit jar. Do not use water from a jug having contained at any time sulphuric acid or vinegar.

Pipette.—The ordinary 17.6 c. c. milk pipette is used for measuring the sample of cream for the test, also for measuring the water in which the tablets are dissolved. The pipette, like the sample jar, should be clean and free from any acid, lye, or sal soda.

Tablets.—The tablets should be kept dry and in a tightly covered box, away from any excessive moisture, and out of direct sunlight. Use for the test only perfect tablets. Use no broken tablets. Pay no attention to the color of the tablets other than that they give a cherry-red color when dissolved in 17.6 c. c. of water.

Suggestions for conducting the daily tests.—On arriving at the station, or as soon after as possible in the morning, take as many sample jars as tests will be required during the day, place in each one tablet and 17.6 c. c. of water, and close the cover. This will require only a short time and the tablets will be dissolving and will be ready for making the tests when the cream arrives. Proceed with the tests according to instructions already given. Should more tablets be dissolved than are needed, throw away the solution; do not attempt to keep it for use the next day.

Summary.—For each test dissolve one perfect tablet in 17.6 c. c. of pure water. Take a 17.6 c. c. sample of cream to be tested. If, when the cream is mixed with the tablet solution, the pink color remains, the cream is sweet enough to grade No. 1. If the color disappears, the cream is sour and grades No. 2. Keep everything in connection with the test free from acid, lye, or sal soda. Keep the tablets in a dry place.

The tablets used for this test are made in the chemical laboratory of the company sending out the foregoing directions. They are not as yet on the market. If the test proves a success in the operations of this company, the various supply houses will undoubtedly put tablets on sale.

It is not thought that this will cure all of the ills of the creamery business, but it will go a long way toward establishing a grade or line of demarcation between good and bad cream. It is, perhaps, only the first step of what should ultimately be considered the right thing in grading cream. If creamery men and patrons alike will look upon this as a means to an end—namely, that of improving the quality of cream from farm separators until the greater part of the cream delivered will make high-grade butter—this scheme of grading and the work leading up to it will not have been in vain. The author has no fear of the ultimate outcome of the farm-separator system if all who are concerned in it make the best use of the means they have at hand and study to know more about the business and to make a high quality of both cream and butter—the end to which all efforts should be bent.

VIII. SUMMARY.

The keynote of this bulletin is the one word *quality*. The introduction and opening discussion give a brief history of dairy progress in the West and some of the reasons why the farm separator is a necessity on the Western farm. In the second division the farm separator, its care and management, are discussed. This deals with the factors influencing separation, including speed of machine, temperature of milk, quantity of milk flowing through the bowl, the cream screw, and the factors of change in season, period of lactation, and richness of milk. The sanitary condition of the separator is specially emphasized. It must be kept absolutely clean. To insure this it must be washed after every separation. A good brush should be used for washing. Discard the dishcloth and dish towel.

Under "Management of cream on the farm" the first essential mentioned is clean milking. The dirt and dust adhering to the cow's udder should be wiped off with a damp cloth before beginning milking. In separating the milk should be poured directly into the supply can of the separator without the intervention of any strainer and while it still contains its animal heat. The cream should be caught in deep narrow cans for cooling. The farmer should be provided with a thermometer and some instrument for stirring the cream. Immediately

after separation the cream should be cooled to the temperature of the water direct from the well. For holding the cream the farmer should be supplied with a tank and windmill. All water pumped should be run through this cooling tank. The tank should be placed in a good milk house. This milk house should be kept free from everything except the milk and the utensils for handling it. Never mix warm cream with cold, as it is always sure to cause quick souring. In delivering the cream to the station or creamery it should be covered with a wet blanket in summer to prevent heating and a dry blanket in winter to prevent freezing. The frequency of delivery depends largely on the distance from the station and the ability of the patron to keep his cream sweet. Although it is believed that with proper care on the farm the cream can be delivered from thirty-two to seventy-two hours old in a sweet condition, the general rule should be to deliver it just as soon as possible after thorough cooling.

Experiments carried on at Colby, Kans., are next dealt with. The data here given and the deductions drawn from them sustain the statements and recommendations before set forth.

The question is then taken up from the creamery man's standpoint. The uncleanness of stations is no more to be excused on the part of the creamery man than is a dirty separator on the part of the farmer. Creamery men need to look well to this point. The methods of receiving cream are discussed under four general heads. The advisability of equipping a series of stations with pasteurizing outfits is doubtful unless large quantities of sweet cream can be secured. This conclusion may be disproved on further investigation, but deductions made from the work done at Colby are unfavorable to pasteurization at the stations. In shipping cream without pasteurizing the same precautions as to cleanliness and grading of cream should be observed as in the pasteurizing station. Means should be provided to secure hot water or steam in abundance. The handling of cream through a store is to be discouraged on every hand. It begets the same conditions that prevail in the handling of country butter. The direct shipper is at a great disadvantage so far as quality is concerned. In opening new territory direct shipping may be admissible, but as soon as twenty or more patrons are secured a receiving station should be established. The transportation of cream is still in a very backward state. Poor cars for the purpose are used and only the large companies have this service. With the development of the business the railroads will undoubtedly furnish better facilities for transportation.

An account is given of the experimental work in the shipment of cream from Colby to Topeka, Kans., covering shipments of sweet and sour cream, both pasteurized and raw, and the results are given in tabular form. One important deduction from this work is that it does not pay to pasteurize sour cream at the shipping station.

In conclusion the system of cream grading is dealt with. It is a system recommended by the author and adopted by a prominent creamery company. The observations and experiences of extended travel over the Western dairy territory and the investigations made at Colby, Kans., indicate that this scheme is entirely feasible. The result of its workings can not now be given, as it has been in operation only since January 1, 1904. It is based on the fact that an acid test gives a very fair indication of the quality of the cream. The dividing line between the grades 1 and 2 is made at 15 c. c. by Mann's test. The instructions given for making the test are taken bodily from a pamphlet issued by the above-mentioned company to their station operators.

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(Continued from second page of cover.)

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| <p>Dr. F. D. Ketchum, South St. Paul, Minn.
 Dr. C. Loveberry, room 402 Custom-House (new),
 Portland, Oreg.
 Dr. H. D. Mayne, Malone, N. Y.
 Dr. J. Miller, care John Morrell & Co., Ottumwa,
 Iowa.
 Dr. C. L. Morin, St. Albans, Vt.
 Dr. A. B. Morse, care The Agar Packing Co., Des
 Moines, Iowa.
 Dr. W. J. Murphy, care Springfield Provision Co.,
 Brightwood, Mass.
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 Kans.
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 Athena, N. J.
 Dr. H. T. Potter, Calais, Me.
 Dr. J. O. F. Price, care Brittain & Co., Marshall-
 town, Iowa.
 Dr. A. G. G. Richardson, Room 16, Deaderick
 Building, Knoxville, Tenn.</p> | <p>Dr. W. H. Rose, 18 Broadway, New York, N. Y.
 Dr. F. L. Russell, Orono, Me.
 Dr. J. F. Ryder, 141 Milk st., Boston, Mass.
 Dr. W. A. Savage, Aurora, Ill.
 Dr. E. P. Schaffter, care Cleveland Provision Co.,
 Cleveland, Ohio.
 Dr. C. A. Schaufier, 134 South Second st., Phila-
 delphia, Pa.
 Dr. Thos. W. Scott, care The Rath Packing Co.,
 Waterloo, Iowa.
 Dr. T. A. Shipley, care T. M. Sinclair & Co. (Ltd.),
 Cedar Rapids, Iowa.
 Dr. N. C. Sorensen, care Kingan & Co., Indian-
 apolis, Ind.
 Mr. Wm. H. Wade, Animal Quarantine Station,
 Haleshorp, Md.
 Dr. H. N. Waller, 109 West 42d st., New York, N. Y.
 Dr. G. W. Ward, Newport, Vt.
 Dr. B. P. Wende, Live Stock Exchange Building,
 East Buffalo, N. Y.
 Dr. W. H. Wray, 39 Hawarden Grove, Herne Hill,
 London, S. E., England.
 Dr. C. H. Zink, care Western Packing Co., Denver,
 Colo.</p> |
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DAIRY INSPECTORS.

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|--|--|
| <p>W. D. Collyer, 210 South Water st., Chicago, Ill.
 James Hewes, 2110 North Charles st., Baltimore,
 Md.
 M. W. Lang, Department of Agriculture, Wash-
 ington, D. C.
 E. A. McDonald, 58 and 59 Downs Block, Seattle,
 Wash.
 Wm. E. Smith, 168 Chambers st., New York, N. Y.</p> | <p>B. F. Van Valkenburgh, 168 Chambers st., New
 York, N. Y.
 E. H. Webster (in the field, or), Manhattan, Kans.
 Levi Wells, Spring Hill, Bradford County, Pa.
 G. M. Whitaker, P. O. box 1332, Boston, Mass.
 W. D. McArthur, 114 California st., San Francisco,
 Cal.</p> |
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